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Birds and Insects in Relation to Horticulture in Northeastern Ohio, 1879-1899

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On February 6, 1879, the Portage County Horticultural Society was organized by 14 charter members and their families. This action had been stimulated by a state meeting of the Ohio Horticultural Society which met for its Eleventh Annual Meeting in Ravenna in 1877. The new county group became successful at once and filled an important need in the community. Proceedings of the monthly meetings were published regularly through most of its existence from 1879 to 1932. These records were prepared for the most part by the Rev. Andrew Willson who served as Secretary for 31 consecutive years, beginning with the organizational meeting. Among other things, the proceedings give a synopsis of problems involving birds and insects as they pertain especially to horticulture, and these topics were often discussed at length at the meetings. The following account, which is based upon such reports during the first 20 years of this organization, shows the attitude members held toward birds and insects.

At the second regular meeting held in May, 1879, an essay was presented on the Codling Moth and the damage it does to apples. Damage done by the Plum Curculio and methods of eliminating it were also discussed. Three months later, George W. Dean announced his discovery that the grubs of the Plum Curculio are found in apples as well as in stone fruits. While this may have been known to professional entomologists, it was a new discovery for the horticulturists of this area. Exhibits were brought to the following meeting as proof of this discovery.

In 1880, John C. Catlin read a report at the October meeting on "Birds and Insects in Their Relation to Horticulture." Some of the matters he discussed were scale insects of apple trees eaten by Orioles; grubs eaten by Wrens and Robins; mosquitoes eaten by the Purple Martin; Wireworms eaten by the Woodcock, and insects under the bark of apple trees devoured by the Nuthatch, Brown Creeper, and Chickadee. He concluded that "were it not for the destruction of insects by the different species of birds, there would be such an increase in numbers as would in a few years make the cultivation of fruits impossible." George Dean commented that while he formerly considered the Crow-Blackbird (Grackle) as a destructive animal, he now respected it for its feeding on harmful insects. The Robins, however, he found to be destructive to his fruits. George Streator added that, in his experience, the Robin did more good than harm, and generally ate more insects than fruit. Catlin made the same statement for the Catbird, and then quoted Dr. Jared P. Kirtland, recommending that enough fruit be planted for both man and the birds. Catlin also pointed out that House Sparrows, generally regarded as a nuisance, fed on grubs of flies that affect horses.

Secretary Willson wrote in his proceedings of the meeting, " 'Do birds do more good than harm?' was earnestly discussed. Generally the birds were favored, and their failings excused, but of some varieties, especially the Robin, severe things were said. The burden of the argument seemed in favor of the affirmative. Some members paid their respects to toads and skunks and plead for their lives, as they are valuable friends of the horticulturalist."

At the meeting for January, 1881, a special report was given on the meeting of the State Horticultural Society, at which Prof. C. V. Riley was the guest speaker, lecturing on insects injurious to horticulture. A discussion of long standing developed on whether or not the Honey Bee could puncture fruit and thus damage it, or whether the bees simply feed on the fruit after birds and wasps have broken the skin. Prof. Riley, explaining the mouth parts of the honey bees, was convinced they break through the fruit. This matter was argued back and forth at meetings of the Portage County group in future years as different ones presented their experience and convictions. Also, Prof. Riley confirmed at the state meeting Dean's discovery that the Plum Curculio is occasionally found in fruits other than stone fruits.

At the next monthly meeting, a committee on Ornithology and Entomology was appointed for the first time with George Dean serving as chairman. Dean exhibited apple and plum Curculios and read from a letter he had received from Dr. Riley. These two men did not agree on the relative number of the two types of curculios found in apples, although Dr. Riley admitted that in certain situations the Plum Curculio might be commonly found in apples.

At the August meeting that year, Dean, in his report as Chairman for Ornithology, commented on the common expression that, "Birds can live without man, but man cannot live without the birds." He claimed that this was an exaggerated and unscientific statement. He pointed out that many birds are neutral and many others are destructive. While Orioles, Grosbeaks, Bluebirds, Swallows, Wrens, Sparrows, and Finches are useful to man, others will destroy beneficial insects. Robins and Catbirds destroy cultivated fruits and consequently they should not be protected. Some insectivorous birds feed on Honey Bees. Dean favored the encouragement of toads rather than birds for horticultural areas. The following summer Dean reported that while on a visit to Lake, Ashtabula, and Trumbull Counties, he had found Robins were destroying the pea crop.

The argument over the value of Robins continued over several years' time. In May of 1884, Dean admitted that Robins do destroy some insects, but many of these, he believed, are not injurious, and he pointed out that one Robin will eat as much as a half pint of cherries each day. At his nursery he could count as many as 300 Robins feeding on his cherries at one time. He considered the Catbird even more destructive. Some members of the Society repeated the proposal made earlier by Dr. Kirtland, that enough fruit be planted for both man and the birds. Two years later, Dean advocated in his relentless attack on the problem, "Kill all Catbirds, save five Robins in every quarter section, and never destroy Crow-Blackbirds." Many members of the Society believed that Dean had too much faith in the value of Crow-Blackbirds (Grackles), but still they were in favor of protecting them because of the insects they devoured.

At the following meeting Dean revised his earlier opinion with the statement that, "more than one pair of Robins in a township is too many." He repeated his conviction that Crow-Blackbirds were beneficial because of their insect-eating habits and claimed that he did not find them damaging his corn. Also, Dean did not believe that the English Sparrow was very destructive, but he regretted its introduction to this country. In this regard he said, "the idea of these importations was the concept of the most ignorant superstition—the belief that all birds are useful."

At the January, 1887, meeting an article written by E. P. Powell was read from the New York *Independent* to refute some of the ideas expressed by George Dean. Powell wrote about "our allies, the birds," and "our absolute dependence on these creatures in our war with our worst pests." He claimed that "My Catbirds are pecuniarily more profitable to me than the help that delights in wearing their wings on Sunday—Our best friends are the birds, but our very worst, most destructive, intolerable pest is the English Sparrow—it attacks all grains and all fruits." He blamed the puncture of grapes onto the English Sparrow, and was one of those convinced that honey bees could not do this damage, but simply fed on the grapes after being punctured by the birds. To him the English Sparrow "will be the most ruinous of all our foes." George Dean commented that he was really a friend of the birds, but did not want too many Robins about. He reiterated his statement that birds not only destroyed harmful insects but also destroyed useful insects, and his belief that bees were capable of puncturing grapes, so that birds were not always responsible for this damage. He made one point in favor of the English Sparrow. He found this species would drive away the Bluejays, and thus save his corn crib.

The argument was continued at the September meeting when George J. Streator presented a paper entitled "Does the Honey Bee Injure Any of the Fruits?" He concluded from his own observations, conversations with others, and readings on the subject that bees do not break the skin of sound fruit. He quoted Warren Pierce, a bee-keeper of Garrettsville, "I believe birds to be the cause of principal damage."

Streator also quoted from a *Farmer's Bulletin* which claimed that Honey Bees have no chewing mouth parts (sic) and can only suck liquids. Consequently, it was claimed that fruit is damaged by hornets, wasps, or birds rather than by Honey Bees. Many entered the discussion, but not all were convinced that the Honey Bee is blameless.

At the next meeting George Dean, as chairman of the Committee on Entomology, continued the debate with the conviction that bees can break through thin-skinned or over-ripe grapes. He read a testimony from C. C. Gardner, who had observed bees breaking the skin of very ripe Concord grapes. He also read testimonials that wasps, crickets, and katydids damage fruit. Prof. Claypole of Buchtel College agreed with Dean that the Italian Bee is capable of puncturing grapes.

At a meeting the following year, Joseph Heighton reported that bees can puncture peaches. One member stated that bees did not harm his raspberries, but Black Wasps were the worst enemy of summer fruit on his farm, while another member retaliated that Italian bees did destroy some of his raspberries. Frank Ford, Chairman of the Committee on Ornithology, supported Dean's earlier complaint against Robins, with the conviction that, "Robins are great enemies of the fruit grower and should be exterminated. The law forbidding a man to kill birds on his own farm should be repealed."

In September, 1888, George Streator reported to the group that curculios had destroyed his plums that year and badly injured the peaches. Robins destroyed one-third of the berry crop. George Dean was pleased to note that his friend Streator was converted to the belief that Robins destroy fruit. Joseph Heighton suggested that mulberry trees be planted to attract Robins away from other fruits. He was still convinced that, "On the whole, birds do more good than harm." One of the members pointed out that Robins ate grubs in strawberry fields and wireworms in potato fields. The next year, at the December meeting, George Streator continued the running argument by reading an essay which he had prepared on "Food Habits of the Robin." He concluded, "I became convinced that we are suffering greater losses from our depredations than we could well afford—I am unable to find that the Robin does any appreciable good in assisting me to protect my fruit crop from the attacks of insects or other enemies." He quoted J. W. Green of the Ohio Agricultural Experiment Station who had advocated that "we need a bounty on Robins fully as much as on the English Sparrow." Mr. M. Crawford expressed his opinion that the Robin is "the worst enemy of the fruit grower," and George Dean added this statement about the Robin, "His meat is earthworms and for sauce to the meat, he uses without stint our most luscious and valuable fruits."

At the meeting for March of 1892, George Sadler read a report on "Insects in the Garden." He emphasized that "since the introduction of the (English) sparrow and its increase, driving off the insectivorous birds, there has been a frightful increase in insects which injure vegetation." On the other hand, he pointed out the value of swallows and wrens as destroyers of insects. Three years later, Isaac Tozer presented another essay on birds. He pointed out that "thousands of grubs, insects, worms, more particularly the cutworm, are destroyed by birds—the food of younger birds is almost entirely insects." On the other hand he pointed out damage done by crows. Mr. Bartlet on the contrary claimed that, "Crows are my favorites, they follow the plow and destroy bugs and worms." Mr. Hinman made a plea to protect quail and wrens because of their benefit in destroying insect pests.

In December, 1895, C. H. Sapp reopened the old argument with a discussion on "Horticulture and the Honey Bee." The importance of these insects to pollination was explained. Also, he was one of those who did not believe that they can break the skin of grapes and of other fruits. A. D. Olin commented, as many had done previously, that bees do serious damage to raspberries.

Prof. E. W. Claypole of Buchtel College reviewed the subject of migration of birds for the meeting of May, 1896. The following year A. M. Hinman, then serving as Chairman for Ornithology, discussed the matter of new game laws. He explained that "Entomologists tell us that the slaughter of birds is to blame for the multiplication of old pests and for the arrival of new ones—the new game law prohibits the destruction of insectivorous birds under certain limitations." He considered this an important step in conservation.

Prof. F. E. Sanford sent a paper to be read at the meeting for July, 1897. This was entitled, "A Chapter in Economic Ornithology," and was based upon an issue of the *Farmer's Bulletin*. This report pointed out that 42% of the food of the Robin consists of insects and other invertebrates. It was estimated that ⅓ of the Robin's food consists of noxious insects, wild fruits make up 47%, and only 4% is from cultivated fruits. Forty-one species of wild fruits were found in this study, while only seven species of cultivated fruits were identified. Dr. Elliott Coues was quoted for his stand that, "the prejudice that some persons entertain against the Robin is unreasonable." The Catbird, however, was found to be more destructive with 19% of its food consisting of cultivated fruits, and only 37% of wild fruits. The Cedar Waxwing proved to have a diet of 13% cultivated fruits, but an equal amount of insect pests. The Meadowlark was found to be very beneficial with ⅔ of its diet consisting of grasshoppers. During the discussion Dr. Sadler reported that his brother had tried the suggestion of planting mulberry trees to attract the birds away from the cherries and this method proved to be successful. George Streator claimed that the Robins still raided the strawberries and raspberries, and for that reason he considered the Robin more harmful than beneficial. Prof. G. H. Colton of Hiram College defended the Robin by asserting that we do not fully realize the number of insects it destroys.

In December, 1898, A. M. Hinman, Chairman of the Committee for Ornithology, read a report from the Audubon Society of Pennsylvania on "Protecting the Birds." This was largely concerned with the elimination of using feathers for millinery purposes. One year later Mr. Hinman presented "A Plea for the Quail." He pointed out that quail feed on insects, weed seeds, and waste grain. Accordingly, this bird should be protected because of its benefit to agriculture. Gradually most members were convinced of the economic value of the great majority of birds.

We thus see that birds and insects received much attention during the first twenty years of the Portage County Horticultural Society. While some of the problems may not have been solved to the satisfaction of all members, at least everyone had an opportunity to express his own observations, convictions, and recommendations. Certainly all members became aware of the importance of birds and insects relative to the successful promotion of horticulture, whether they were harmful or beneficial.

The Story of Grafting in Stentor

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THE LARGE and exquisite blue-green trumpet ciliate, *Stentor coeruleus,* has proved to be micrurgically the most operable of all cells. Were it called for, one could, on the same stentor, excise the tail-pole, remove thirteen-fifteenths of the macronucleus and replace it with two-elevenths of that of a different species, transplant a patch of the cortical ectoplasm in reverse, graft in heteropolar parabiosis to another cell, cause both peristomes to be shed by brief treatment with dilute urea, inject a bit of some solution, and test further consequences of some substance added to the medium on the resulting regeneration! That such specimens could be prepared is largely the result of the graftability of stentors, a relatively recent development with a long history of emergence.

Appropriately, stentors were discovered by Abraham Trembley who also demonstrated in his remarkable experiments on Hydra that even tiny organisms could be grafted. In his search for hydras he found other "polyps" too small for operation under his early version of the microscope, and from his description these were undoubtedly stentors. His letter to the Royal Society of London in 1744 described three species of "funnel-like polypi" (apparently misprinted as tunnel-like) distinguished by differences in color, noting that they accept certain food particles while rejecting others, as well as how they cut themselves in two for reproduction. The fission line is oblique, to carve the forward-forming second set of feeding organelles into the posterior daughter while dividing the parent cell into equal volumes.

A century and a half later, August Gruber performed the first cutting experiments on Stentor. Following Nussbaum's (1884) initial explorations with Oxytricha, Gruber (1885) artificially divided stentors by transection with a tiny scalpel. Achieving two regenerated fragments comparable to daughter cells, this simple operation in its day must have seemed a triumph of experimental duplication of nature's ways, for man could now produce the division of cells at will. Gruber then cut *S. coeruleus* into three or more pieces, and his sketch of the trisected stentor is familiar even today. Exceeding natural division, all the fragments regenerated into perfect tiny stentors and the wonder of regeneration on the cell level was revealed. As Driesch implacably emphasized, referring to this example among others, living entities differ fundamentally from inanimate ones because parts can become wholes.

Gruber was chiefly interested in the question of the dispensability of the cell nucleus; yet he paid careful attention to wound healing in his stentor fragments, and it was this which led him to the first attempts to graft ciliates. Anucleate fragments could be most easily obtained by cutting off the ends of stentors in division when the chain macronucleus is temporarily clumped together in the center. Such pieces swam merrily away and survived for several days. Separation from the nucleus was therefore not immediately lethal. The wound surface healed gradually, and if the piece happened to contain the division primordium already well started, this too ran its course in the absence of the nucleus. But anucleate fragments could not initiate regeneration nor could they regenerate a nucleus from the cytoplasm and they eventually succumbed.

The macronucleus was thus shown to be indispensable and normally irreplaceable. From his account it is clear that Gruber did not like to admit this point, perhaps because he was initially more impressed with the persistence of normal behavior in anucleate fragments of both Stentor and Actinophrys. In the latter, a heliozoan, Gruber (1883) had observed that the contractile vacuole remains active, pseudopodia extend and capture food, and pieces will fuse with each other even though lacking a nucleus. He even claimed that they can grow, but this impression may have been due to fusions which he had not noticed. In the end, Gruber admitted the indispensability of the nucleus in protozoa and noted that this confirmed discoveries that were then being made in genetics and fertilization; yet he insisted that anucleate pieces might some day be shown to be capable of regeneration and continued survival "under circumstances not yet devised".

Having observed the fusion or self-grafting of Actinophrys, Gruber conceived that if the wound areas of two separated stentor fragments were pressed together before they had healed the pieces should then unite. This he accomplished as we cannot doubt, though he said nothing further concerning the subsequent fate of these grafts. He merely remarked that, in joining, the cortical stripes of the two pieces do not necessarily match. Keeping to his major concern with nucleocytoplasmic relationships, Gruber was satisfied to have demonstrated that grafting is possible.

Balbiani then published a nice series of studies on regeneration in Stentor and other ciliates (1891–2–3). We include him in our history because he discovered and described conjugation in Stentor, a sort of self-grafting in which two cells temporarily fuse by the apposition of wound-like rifts in the ectoplasm adjacent to the peristomes. This behavior again suggests the possibility of artificial unions.

In 1901, T. H. Morgan carried Gruber's investigations a step further and found that pieces of *Stentor coeruleus* formed heads and tails proportionate to their size, that nucleated fragments as small as 1/64th the size of the whole can regenerate tiny stentors, that the normal regeneration primordium site is dispensable, and that the more of the orginal feeding organelles left in the specimen the slower the initiation of their regeneration will be. Gruber's discursive and seemingly ambiguous notes have led to many contradictions in the reading. Some have said that Gruber claimed regeneration without the nucleus though his final conclusion was the opposite, while others have him asserting that even some nucleated fragments would not regenerate although I can find no such statement. Morgan attributed to Gruber the notion "that pre-formed elements of the peristome exist in the nucleus and must be set free in order to initiate the development of a new peristome". Then note Morgan's statement: "That the presence of the nucleus is connected with the formation of a new peristomial band seems highly probable, but I can easily imagine that could a non-nucleated piece be supplied with certain unformed elements it might be capable of producing a new peristome. The results do not seem to me to show more than that the nucleus supplies certain products of metabolism that must be present before the protoplasm can successfully carry out its innate tendency to complete the typical form." This remark is not substantially different from Gruber's conjecture that under conditions not yet devised anucleates might also regenerate. Both statements anticipate that the contribution of the nucleus to the cytoplasm is of a substance nature and that some day, perhaps by supplying stentor RNA or DNA directly, we may find that the nucleus as their intrinsic source is unnecessary for synthesis and morphogenesis.

Then too, Morgan seems to have missed Gruber's remarks that he did get separated fragments to fuse together again when apposed before the wound surfaces had healed. Morgan went on to say that "On several occasions I have tried to graft together pieces of different stentors, but the exposed surfaces closed so quickly that I have not been able to get the pieces to unite. It does not seem altogether improbable that the result could be brought about by cutting two stentors at the same time, one above the other. A lucky cut might bring two exposed inner surfaces together, and they might stick to each other, but so far I have not been able to carry out successfully this experiment." At least Morgan seems to have had a clear and explicit conception of the possibility that stentors should be graftable like hydras and embryos and other metazoan forms.

In the miscellany of his projects Prowazek verged upon being a dabbler, yet his tests and observations were keen and seminal. His 1904 omnibus paper on *Stentor coeruleus* is usually put down as merely a mistakened declaration that the nucleus is unnecessary for regeneration in protozoa, yet it is much more than that. He anticipated the discovery of fluorescent pigment in the blue-green stentor (Møller, 1960) and initiated a series of studies on the effects of salts and other substances on stentor (reviewed in Tartar, 1961) as well as offering other suggestive contributions. In regard to the dispensability of the macronucleus, he reported that after repeatedly cutting a stentor to induce oral replacement the macronucleus could then be removed entirely without precluding regeneration. Likewise, animals that were grown in "warm cultures" at an elevated temperature were apparently able to regenerate after enucleation. In both cases the regeneration was attributed to a condition which causes the nucleus to emit chromidia which could then substitute for it. This was in the days of the chromidia hypothesis which is now defunct, but these reported results were in their way the fulfillment of Gruber's and Morgan's suggestions that if the contribution of the nucleus were otherwise supplied the organelle itself would not need to be present for morphogenesis. The warming effect was tested by Ishakowa (1912) with negative results, yet it is fair to say that these experiments of Prowazek have not yet been carefully rechecked for the possibilities they might offer.

In 1901 Prowazek reported only partially successful attempts to graft amoebas. Sarcodina were from the first the favored protozoa for grafting because they are slow or immotile. The Heliozoa in particular, with their frothy outer cytoplasm and absence of movement, were successfully grafted by Cienkowski (1865) and others. In fact, these animals autonomously fuse together to surround prey too large for any single one to handle. The history of these grafting experiments is presented by Okada (1930). More recently Commandon and DeFonbrune (1939) in France, Danielli and coworkers in England (1959), and Daniels (1951) in the USA have finally developed grafting and nuclear transplantations in amoebas as a feasible technique for exploring many interesting problems.

Oddly enough, Prowazek did not attempt to graft his stentors but he did have a tiny success with another ciliate. In 1901 he reported that he was able to cut the little Glaucoma and get the fragments back together again under a cover slip although adhesion was only temporary. At least a ciliate had again been grafted, with the indication that this is possible in other ciliates than stentors.

In the next step I have to discuss my own role in this development. The first lecture I attended at Yale was Ross Harrison's discourse on regeneration in protozoa. As a beginning graduate student I conscientiously studied all the literature he made available to us and have been pursuing the subject ever since! In Harrison's department there was much discussion of grafting, morphogenesis and embryological experimentation. Therefore I proposed to work on Harrison's problems using Woodruff's material, i.e., the protozoa; and I obtained the doctorate under L. L. Woodruff with a study on regeneration in Paramecium.

A language barrier kept me from a careful reading of Gruber's reports at that time, and although I read Morgan's paper in 1936 his comment on the possibility of grafting stentors seems to have made no conscious impression upon me at all and is missing from my abstract of his work. I was therefore surprised later to discover his remarks, long after I had succeeded in what he had attempted.

In 1941 I bought a culture of *S. coeruleus* to show this beautiful ciliate to my premedical students, for I thought this animal had been so much studied from the standpoint of regeneration (only the papers concerning grafting have been cited here) to make it unlikely that one could uncover anything new in this direction! I cut some of the animals to demonstrate Gruber's classic experiment on the reconstitution of fragments, but was not entirely successful. Some specimens were not completely transected, for the parts remained connected by a small cytoplasmic bridge; and I noticed that these animals healed together, the union quickly extending from the point of connection over the two fresh wound surfaces. This performance at once suggested to me that if a fresh wound were made in each of two animals and if the two could be quickly brought together, then fusion of two whole cells should be possible. During my free evenings I worked for one month until an enduring graft of two whole stentors was finally made. Because quieting with the best ciliate anaesthetic I knew—nickel sulphate—also prevented proper healing, I simply confined two stentors in a tiny drop and chased them with a glass needle. After a while I could graft as many as 4 stentors together, also demonstrating among the animals which had been cut and re-cut without success that stentors can reconstitute after thorough mincing (Tartar, 1941).

These studies were interrupted by the second World War. Then in 1951, P. B. Weisz carried the work a step further. Combining my technique of grafting and Marsland's (1943) method for quieting paramecia, he retarded stentors for operation in a viscous solution of methyl cellulose and produced many successful fusions. This largely innocuous treatment for cutting and grafting active stentors proved ideal and later made possible many intricate types of intercellular transplantations, limited only by the small size of the animal and the skill of the operator.

Adhesion of stentors is by the endoplasm. The ectoplasm with its tough pellicle and elaborate structures has to be cut through to expose the endoplasm, which then does not flow out but is at once covered by what L. V. Heilbrunn called a precipitation membrane. This delicate membrane is probably produced by a polar orientation of molecules at the surface. By apposing the wound surfaces of two cells and pressing the cells into each other, the wound areas are extended, the membrane broken, and the molecules or fabric of one endoplasm fuse and join intimately with those of the other. It is sufficient to obtain adherence at only one point, as in the original observation of fragments connected by a thread of cytoplasm, for the area of fusion quickly spreads.

Simple transposition of parts of one cell can be accomplished if endoplasmic continuity is maintained between them, as when only the ectoplasm is cut through around the circumference of the cell and the anterior half rotated on the posterior by a nudging action of the needle. The surface pattern of the cell is then misaligned, quite as in some of Gruber's original operations in which the two parts did not fuse in normal orientation. Normal pattern is recovered in one of several ways (Tartar, 1956, 1959). This operation has been most extensively employed for stentor studies by Uhlig (1960), and Suzuki (1957) used the method of transposition of still-attached parts as a remarkably fruitful way of studying morphogenesis in Blepharisma which is doubtless too small for grafting.

Development of skill in grafting has permitted a wide variety of micrurgical operations on stentor. As many as one hundred animals have been grafted together in one protoplasmic continuum (Tartar, 1954). Simpler grafts of two and three animals lead to self-reproducing doublet and triplet biotypes. Any patch—usually a meridional sector—can be reversed in situ or cut from one cell and implanted into an incision in another. Heteropolar combinations of two animals can be prepared, and as many as 4 have been grafted together in tandem. Although not quite so readily accomplished, persisting grafts can be made between different species of Stentor but intrinsic incompatabilities usually lead to their demise.

The principle of adhesion by the endoplasm is used for nuclear transplantation. All the macronuclear nodes can be teased out of one stentor as they become clearly visible in dark-field illumination; and the same is then done with another stentor of the same or different species to obtain a packet of nodes within an endoplasmic envelope. The enucleated animal is then freshly cut open and the packet of nodes is taken with the point of a needle and broken against the fresh endoplasm whereupon the alien nucleus is taken into the cell. Nucleocytoplasmic interactions breeching the natural barriers to intervarietal and interspecific combinations can then be explored.

In the most general terms, what have we learned so far from grafting stentors? First, these unicellular ciliates are indeed not radically different from multicellular forms in their morphogenesis. They can restore the normal form after excision of parts, and minced stentors reconstitute quite as readily as dissociated sponges or the reaggregated cells of embryos. Gradual determination in time of the fate of a developing part is shown in the oral primordium of stentors as in limb blastema or organ buds, for excisions at an early stage are compensated but at a later time in development they result in corresponding defects. Starving stentors diminish in size as they utilize their substance and are remodeled on a small scale as tiny replicas of the normal animal, quite as in flatworms and hydras. As in classic experiments fusing two eggs, parabiotic grafts of two stentors can reorganize as one individuality; and conversely, complete development of fragments of eggs and of stentors illustrates that the single cell "contains" potentially more than a single individuality. In divisions, stentors are in fact continually producing two new individualities from one.

Something like embryonic induction also occurs in stentors. The cell pattern is not isotropic, for the pigmented bands separating the rows of body cilia form a graduated series around the cell from narrow to wide. Where the widest stripes lie next to the finest the oral primordium is formed. Transplantation experiments have shown that wherever a cortical area characterized by fine striping is placed adjacent to one with wide stripes the latter induces primordium formation in the former. In this way supernumerary and ectopic primordia can be produced wherever desired by arranging extra loci of contrasting striping. Moreover, the mouthparts are induced at the posterior end of the developing peristome by reason of its proximity to the terminus of the cell, for if the early primordium is shifted forward it then develops astomatously. Together, these findings demonstrate that many of the principles of multicellular development apply to and can be studied at the level of the single cell.

Second, the cortical pattern of the cytoplasm is thus shown to be as important as the nucleus in determining development. The locus of stripe contrast determines the place and the size and the direction of asymmetry of cell differentiation. Wherever there is such a contrast an oral anlage appears. If the locus of contrast is extensive the primordium is long; if the wide stripe area is on the "wrong" side of the fine stripes the primordium coils in reverse and the mouthparts are formed backwards. Furthermore, if the entire cortical pattern is removed, we have an endoplasmic sphere which remains intact within its membrane for a couple of days but never regenerates even though the nucleus is present. Theoretically, it is difficult to conceive how free molecules by themselves could produce the elaborate and specific forms characterizing organisms. Therefore it may well be that eggs and other cells carry indispensable complex cortical patterns upon which further elaborations are based. Such a pattern is clearly visible in the living pigmented *Stentor coeruleus* and can be manipulated at will by cutting and grafting, making this organism singularly appropriate for investigating the nature and role of a cortical pattern factor.

References Cited

Balbiani, E. G. 1891–2–3. Nouvelles recherches expérimentales sur la merotomie des infusoires ciliés. Annales de micrographie *4:* 369–407; 449–489; *5:* 1–25; 49–84; 113–134.

Cienkowski, L. 1865. Beiträge zur Kenntnis der Monaden. Arch. mikr. Anat. *1:* 201–232.

Comandon, J., and P. DeFonbrune. 1939. Greffe nucleaire totale, simple, ou multiple, chez un Amibe. C. R. Soc. Biol., Paris *130:* 740–744.

Danielli, J. F. 1959. The cell-to-cell transfer of nuclei in Amoeba and a comprehensive cell theory. Ann. N. Y. Acad. Sci. *78:* 675–687.

Daniels, E. W. 1951. Studies on the effect of x-irradiation upon *Pelomyxa carolinensis* with special reference to nuclear division and plasmotomy. J. Exptl. Zool. *117:* 189–210.

Gruber, A. 1883. Ueber die Einflusslosigkeit des Kerns auf die Bewegung, die Ernährung und das Wachstum einzelliger Tiere. Biol. Zentralbl. *3:* 580–582.

——. 1885. Über künstiliche Teilung bei Infusorien. Biol. Zentralbl. *4:* 717–722; *5:* 137–141.

Ishikawa, H. 1912. Wundheilungs- und Regenerationsvorgänge bei Infusorien. Arch. Entw. mech. *35:* 1–29.

Marsland, D. A. 1943. Quieting Paramecium for the elementary student. Science *98:* 414.

Møller, K. M. 1960. On the nature of Stentorin. Compt. rend. trav. Lab. Carlsberg (in press).

Morgan, T. H. 1901. Regeneration of proportionate structures in Stentor. Biol. Bull. *2:* 311–328.

Nussbaum, M. 1884. Über spontane und künstliche Zelltheilung. Sitzber. niederrhein. Ges. Nat.-u. Heilk., Bonn *41:* 259–263.

Okada, Y. K. 1930. Transplantationsversuche an Protozoen. Arch. Protistenk. *69:* 39–94.

Prowazek, S. 1901. Beiträge zur Protoplasmaphysiologie. Biol. Zentralbl. *21:* 87–95; 144–155.

——. 1904. Beitrag zur Kenntnis der Regeneration und Biologie der Protozoen. Arch. Protistenk. *3:* 44–59.

Suzuki, S. 1957. Morphogenesis in the regeneration of *Blepharisma undulans japonicus* Suzuki. Bull. Yamagata Univ., Nat. Sci. *4:* 85–192.

Tartar, V. 1941. Intracellular patterns: Facts and principles concerning patterns exhibited in the morphogenesis and regeneration of ciliate protozoa. Growth (suppl.) *5:* 21–40.

——. 1954. Reactions of *Stentor coeruleus* to homoplastic grafting. J. Exptl. Zool. *127:* 511–576.

——. 1956. Grafting experiments concerning primordium formation in *Stentor coeruleus.* Ibid. *131:* 75–122.

——. 1959. Effects of misorientation by rotation of the ectoplasmic pattern of *S. coeruleus.* (Abstr.) J. Protozool. Suppl. *6:* 32.

——. 1961. The Biology of Stentor. Pergamon Press, Oxford.

Uhlig, G. 1960. Entwicklungsphysiologische Untersuchungen zur Morphogenese von *Stentor coeruleus* Ehrbg. Arch. Protistenk. *105:* 1–109.

Weisz, P. B. 1951. Homoplastic grafting in *Stentor coeruleus.* Biol. Bull. *100:* 116–126.

* * *

TRAPPED

If I am small, as mouse in meager meanness,
My crimes like petty pellets
But litter pantry shelves;
My virtues, invisibly grey
As outsized whiskers, betray
No more than minimal conditioned reflex.

And yet, within—of genetic germ?—I yearn;
Strain toward a spaciousness;
Commit love's shamed largesse;
Would constipate all nuisance;
Fumble for grace, or its semblance.
Die trapped in the tragic, even as heroes burn.

Vera Koehring
Hunter College

A Further Note on Population

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THE EDITORIAL comment on Frazzetta's paper in the January 1961 issue of *The Biologist* merits further comment. There is ample sound ecological observation to back the view of the coming of population stability. The situation in which ecological "law" produces stability is however one of "cultural" or "behavioral" or, in a special sense, "populational" homogeneity, at least of sorts. That situation is one wherein the total population is "at peace with itself"—with its "internal" environment, as it were—and needs only to reach a "peace" with its extraneous environment. Man is *not* in that situation, and I regard it probably a fatal error to assume that in due course of unthinking natural law man will achieve a population equilibrium.

The situation in which we do exist, and which prevents the "laws" to which the editorial refers from operating, is one of tenacious and deadly struggle between population subgroups for control of the entire population. In this atmosphere of struggle and combat no cessation of population production is likely, even by ecological "law"; on the contrary production will, if the expected course is followed, continue until it is no longer "needed," in the strictest evolutionary sense. We are engaged in a combat wherein the successful *combination* of numbers and pressure of annihilation is sought. Numbers alone might tip the scale, either preventing full use of nihilistic powers (for "humanistic" reasons) or in assuring survival of a few in a near-total annihilation. Either way, there is now a distinct survival value in large populations, and whether man as a species is conscious of this or not, it seems inevitable that the increase will continue until the "problem" of who is the better—is to survive—if any at all—is resolved.

It is essential, I think, for there to be "one world" before the forces to which the editorial refers can take effect on a significant, therefore worldwide, scale. Would that technological advancement had been delayed, so that in working out this evolutionary necessity of selecting the sole surviving culture, or true amalgamation of varied cultures, there would not be the present grave risk of near-total or even total genocide or quite possibly biocide. But technology has advanced inordinately, and we are now at its virtually unthinking mercy.

Like Mr. Frazzetta, I am gravely alarmed at the handwriting on the wall. Under the circumstances, however, it seems extremely doubtful that anything will be done about it, primarily because a few visionary individuals are not likely to wield enough power to stay the mass trends already sweeping like a tidal wave toward human or biotic destruction. Mass education in the absolute necessity of cultural homogeneity for man's survival cannot come fast enough. Our concern is ill-timed and should have come two centuries ago. A "crash" program of education even so might yet be successful; it is now the only reasonable hope for avoidance of catastrophe.

If man *should* be able to emerge from the coming disaster without total destruction, then, if communication indeed permits the existence of "one world" at that time, we could expect a population stability such as the editorial describes to be attained. Until that nebulous time when things may "get better" we should be preparing in our own grim way for things to get much worse.

NOTE

As this number of THE BIOLOGIST goes to press, word comes that the National Vice-President of the Phi Sigma Society, Dr. Horton H. Hobbs, Jr., has been selected to become the Chief Curator of Zoology in the United States National Museum in Washington, D.C. Members of Phi Sigma everywhere congratulate and wish Dr. Hobbs well in his new position.

Book Notices

The Watershed. A Biography of Johannes Kepler. ARTHUR KOESTLER. 1960. Doubleday Anchor Books, Garden City, New York. 280 pp., illus. 95¢

This book is taken from the author's *The Sleepwalkers* (Macmillan, 1959). It tells in depth, with full development of both its human and scientific side, the important and eventful life of Johannes Kepler (1571–1630), the discoverer of the laws describing planetary motions. The title, *The Watershed,* refers to the historical position occupied by Kepler on the divide, as it were, between the Medieval past and the modern future. For six years (1615–1621), for instance, Kepler's mother's life hung by a thread under indictment for witchcraft! And twice, from Gratz in 1599 and from Linz in 1626, Kepler was forced to move because he was not a Roman Catholic. Kepler himself held a limited belief in astrology and made much of his income by casting horoscopes. Moreover, the very astronomical books in which he announced his laws were primarily concerned with a search for the "harmony of the spheres". It required Newton's genius, half a century later, to discover Kepler's laws hidden away in his books embedded in masses of irrelevant material and to move on to universal gravitation. Kepler's three laws may be stated briefly as follows: (1) The orbits are ellipses. (2) Reducing the orbit to a plane figure, the planet sweeps out equal areas of the plane figure in equal times. (3) The squares of the periods of revolution of two planets are as the cubes of their mean distances from the sun.

Mark Catesby the Colonial Audubon. GEORGE FREDERICK FRICK and RAYMOND PHINEAS STEARNS. 1961. University of Illinois Press, Urbana. 137 pp., 16 plates. $5.00.

Many beginning biology students are familiar with the scientific name of the bullfrog, *Rana catesbiana,* but few know anything about the man it was named for.

Mark Catesby—the name rhymes with "hates me"—was an English naturalist who lived from 1683 to 1747. Between 1729 and 1747 he published *The Natural History of Carolina, Florida, and the Bahama Islands,* 2 volumes, 200 hand-colored plates—the most important Pre-Revolutionary work on the natural history of the British North American colonies. Most of Catesby's figures and descriptions were subsequently identified with binominal species and, in many cases, served as the basis of species recognized by Linnaeus and others. Catesby was primarily a botanist, but his chief fame was as a student of birds, of which he figured 109 species, some 75 of which were named on the basis of Catesby's book. Of fishes, some 31 species can be identified from Catesby's plates. Three turtles, 6 lizards, 5 amphibians, 7 crabs, a few insects, numerous snakes and mammals and, of course, many plants were likewise figured.

The authors of the present book have brought together the scanty information now available on Catesby. The circumstances of his visits to Virginia (1712–1716) and South Carolina (1722–1726) are related as well as his relations with his sponsors and patrons, the principle of which were William Sherard and Sir Hans Sloane. The writing and subsequent influence of Catesby's book are recorded. Sixteen of Catesby's plates are reproduced in black and white. One might have wished the authors had listed all the species treated by Catesby. Only the fishes are so listed, but many of his other species identified are in the footnotes. An appendix gives an account of one Thomas More, an Englishman who did some natural history collecting in New England in the 1720's.

John and William Bartram's America. Edited by HELEN GERE CRUICKSHANK. 1961. Doubleday & Co., Inc., New York (Natural History Library No. 2) 378 pp., 8 plates, 2 maps. $1.45 (paper).

To the many of us whose previous knowledge of the Bartrams has been brief references in our history books, the present volume offers a welcome opportunity for more personal acquaintance. John Bartram (1699–1777) and his son, William Bartram (1739–1823), of Philadelphia stand almost alone as native American naturalists in the eighteenth century. Through brief biographical sketches, selected letters, extracts from their published books of travels (1751, 1767, 1791) and unpublished manuscripts, the Bartrams are made known to us. Zoological observations are collected in Chapters 13–16 (pp. 226–274), the most remarkable of which are, perhaps, William Bartram's account of the extraordinary number of alligators encountered near the entrance to St. John's River in eastern Florida 1765–1766.

Laennec: His Life and Times. ROGER KERVAN, M.D. translated by D. C. Abrahams-Curil. 1960. Pergamon Press, New York. 213 pp., $3.50.

Theophile Laennec (1781–1826) was the French physician who, by about 1818, introduced mediate auscultation by means of the stethescope as an aid in the diagnosis of diseases of the chest. This book gives in pleasing detail the story of Laennec's unfortunate but fruitful career. Born in Brittany, brought up by his physician-uncle in Nantes where, in 1794, he witnessed the full horror of the reign of terror, an eventual victim of the chronic tuberculosis to the diagnosis of which he contributed so much, deprived of proper recognition in Paris until failing health made it too late, this book tells the fascinating story of Laennec's life. If the book lacks at all, it is, perhaps, in not making sufficiently clear the situation in medicine against which Laennec worked and the full implications of Laennec's discovery.

Readers of the present biography may be interested to be reminded that essential portions of Laennec's famous book have recently been published in English translation in Camac's *Classics of Medicine and Surgery* reprinted by Dover Publications in 1959.

Charles Darwin. The Founder of the Theory of Evolution and Natural Selection. GERHARD WICHLER. 1961. Pergamon Press, New York. 228 pp., 24 plates. $6.50.

If one's first reaction to this book is "What! Another book on Darwin!" he is doomed to pleasant disappointment. The author is a German who died in 1960. His book is a most refreshing addition to the Darwin literature. He discusses, for instance, the status of evolutionary thinking in the period before 1859; he marshals in most striking fashion the reasoning which kept most biologists from a belief in transmutation; and he emphasizes Darwin's great genius and insight in bringing about the revolution in biological thinking that he accomplished. There follow short sections on numerous other specialized aspects of Darwin's life, including his financial situation, his circle of friends, and his religious beliefs. It is an essential item of Darwiniana.

The Origin of Species by Means of Natural Selection or the Preservation of Favored Races in the Struggle for Life. Ed. 6. CHARLES DARWIN. 1961. Doubleday Dolphin Books. 517 pp. 95¢.

The Origin of Species is probably the most extensively reprinted biological book ever written despite the fact that, for the present day student, it is formidable reading. The ridicule that greeted certain of the phylogenetic speculations in *The Vestiges of the Natural History of Creation* in 1844 resolved Darwin to avoid any detailed phylogeny in his book. The proposal to account for the world of organisms by means of descent with modification guided by natural selection was sufficiently revolutionary by itself. The result was a relatively formal and closely reasoned argument for evolution in its most generalized form.

The present book is from a resetting of

the type of the sixth edition of 1872. It is unfortunate that when a scientific work like this is reprinted, it is not done in photographic facsimile of the original. Or, at the very least, if resetting of the type is considered desirable, the original page numbers should be inserted in square brackets at the appropriate places. In this way, page references would be the same for both the original and the reprint.

The Origin of Species was originally published in November, 1859. Between that date and February, 1872 when the sixth edition appeared, about three-fourths of the sentences in the first edition were modified or eliminated and almost 40% of new material was added. The result is that if one wants to know what Darwin said in any one edition, that edition and that edition alone must be consulted or referred to. A reprint, with altered punctuation, of the first edition was published in 1950 and somewhat later there likewise appeared a reprint of the second edition of January, 1860. In 1959 a variorum text of all six editions was published by the University of Pennsylvania Press, but it is so arranged that it is not suitable for continuous reading. All other reprints so far as known to the reviewer are of the sixth edition of 1872. To think of Darwin's book as having appeared in 1859 and then to refer to the 1872 edition to find out what he said in 1859 is hazardous in the extreme.

Louis Agassiz. A Life in Science. EDWARD LURIE. 1960. University of Chicago Press, Chicago. 449 pp., illus. $7.50.

Louis Agassiz (1807–1873), at the age of 22, resolved to become the first naturalist of his time. Though he missed this, he did become the first zoologist in America, and in 1858 turned down the directorship of the French National Museum of Natural History in Paris. The present volume is a thoroughly satisfactory study in depth of this amazing man: early bemusement by Oken's *Naturphilosophie* in Munich, conversion to Cuvier's idealism in Paris, 14 years of fossil fish and glaciers at Neuchatel, and 25 years of the Museum of Comparative Zoology and opposition to Darwinism at Cambridge.

The reviewer feels that a somewhat more effective presentation of Agassiz's life in America would have been a more strictly chronological arrangement and also that the full impact of Agassiz on American zoology could have been stressed by a bit more detail concerning the achievements of Agassiz's many students. It is a fine book, however, and it and Dupree's *Asa Gray*, noticed in the previous number of THE BIOLOGIST—neither author has read the other's work—gives us portraits of the two Harvard professors who in the third quarter of the last century were respectively the leading zoologist and the leading botanist in the United States. The two books together constitute an absorbing chapter in the history of biology in America.

Radioactive Substances. MARIE CURIE. 1961. Philosophical Library, New York. 94 pp., portrait of author, $2.75.

This is a translation from the French of the classical thesis presented to the Faculty of Science in Paris by the distinguished Nobel Prize winner. As such it will be valued by persons interested in the early history of the study of radioactivity. Unfortunately, the book gives no indication as to when or where the document that is being translated originally appeared. Moreover, the translator on p. 2 did not appreciate the difference in meaning between the French "actuel" and the English "actual"; he speaks of the "actual Director" meaning "present Director."

Michelson and the Speed of Light. BERNARD JAFFE. 1960. Doubleday & Co., Inc., Garden City, N. Y. 197 pp., 14 figs., 4 plates. 95¢

A readable, but not especially profound account of Albert Abraham Michelson (1852–1931). Michelson's contributions to our knowledge of the speed of light are well and adequately told, but the book contains no real insight into the man himself. Bibliography.

Classics in Psychology. Edited by THORNE SHIPLEY. 1961. Philosophical Library, New York. 1342 pp. $20.00

This is a collection of 36 extracts from the writings of 38 authors appearing over the last 160 years. In its pages one may read the original statements of many of the viewpoints that have become psychological classics. Wundt, Von Helmholtz, Mach, Titchener, Rush, Sherrington, Adler, Binet, and Rorschach are among the authors represented. William James on "The Stream of Thought," Pinel on "Insanity," Pavlov on "Conditioned Reflexes," and John B. Watson on "Behaviorism" are samples of the topics covered. Each selection concludes with a brief biographical sketch of the author quoted together with a brief bibliography of pertinent references. There is a concluding index of proper names. This is an important work of reference.

Letters To My Teacher. DAGOBERT D. RUNES. 1961. Philosophical Library, Inc., New York. 105 pp. $2.75

The author of this interesting little book is an angry man attributing the tragic shortcomings of Western Civilization in important measure to defects in its system of education. Obsessed by the Nazi massacre of the Jews and the equally terrible slaughters of political dissidents by Russian and Chinese communists, he insists that an education that does not inculcate love and a spirit of cooperation is not only futile but dangerous. Among the aspects of traditional education that are singled out for animadversion are a spirit of emulation and competitiveness, foreign language study that does not result in an effective mastery of the language, biology that is bogged down with taxonomic names and morphological terminology, and history that is preoccupied with dynastic succession and military detail.

A Dictionary of Scientific Terms. Pronunciation, Derivation, and Definitions of Terms in Biology, Botany, Zoology, Anatomy, Cytology, Genetics, Embryology, Physiology. I. F. HENDERSON and W. D. HENDERSON. Seventh Edition by J. H. KENNETH. 1960. Van Nostrand, Princeton, N. J. 595 pp. $12.50.

This is a handy volume to put beside a Webster's *Collegiate Dictionary* on the ready reference shelf. It will save many trips to the unabridged dictionary as well as defining many terms not in the latter at all. The technical vocabulary in English is so immense that no dictionary is very complete, but this one helps. It defines some 15,600 terms, an increase of 1,750 over the previous edition.

Style Manual for Biological Journals. CONFERENCE OF BIOLOGICAL EDITORS. 1960. American Institute of Biological Sciences, Washington, D. C. 92 pp.

A useful authoritative brief style manual for writers and editors of scientific papers.

Cybernetics Without Mathematics. HENRYK GRENIEWSKI, translated by Olgierd Wojtasiewica. 1960. Pergamon Press, New York. 201 pp., illus. $6.00.

The present book presents the foundations of cybernetics. No knowledge of mathematics is required from the reader except an ability to read very simple tables. In the chapter on "Biological Models," a model is set up and explained which the author claims to be that of a conditioned response.

Water, The Mirror of Science. KENNETH S. DAVIS and TOBIN A. DAY. 1961. Anchor Books (Doubleday), Garden City, N. Y. 195 pp., illus. 95¢.

In this original for Anchor's Science Study Series (S 18) a writer and a meteorologist have combined their resources in using water—that simple compound with nevertheless unique properties, of cardinal importance in man's external and internal environment—as a subject not only of great interest and profound significance in itself, but also a theme for integrating the

student's or reader's introduction to scientific method and discovery, chemistry, physics, geology, meteorology, biology, and applied science as pertaining to man's uses and need of water. The result is highly commendable: a fascinating scientific study which will inform citizens regarding an important aspect of their world and should inspire students to science.
—Vance Tartar

The Nature of Violent Storms. LOUIS J. BATTAN. 1961. Doubleday & Co., Inc., Garden City, N. Y. 158 pp. 95¢.

This is a scientifically competent popular account of the physics and meteorology of the air movements that produce storms. The account ranges from thunderstorms and tornadoes through hurricanes to cyclonic storms. The author suggests that a number of wide ranging artificial satellites reporting back to earth may in the future make possible the mapping and forecasting of weather conditions on an hitherto unprecedented scale. The book concludes with three pages of additional readings.

The Exploration of the Colorado River. JOHN WESLEY POWELL. 1961. Doubleday & Co., Inc., Garden City, N. Y. (Natural History Library No. 11). 176 pp., 8 plates, map. 95¢ (paper).

This is a reprint of the work first published by the Smithsonian Institution in 1875 as *Exploration of the Colorado River of the West and its Tributaries*. It tells of the famous first descent of the Green and Colorado Rivers in 1869 from Green River, Wyoming, to the mouth of the Virgin River in Arizona. It is an exciting story of men who never knew when the next bend in the canyon would reveal an impassible cataract. Fortunately, none such appeared, and Major Powell—one-armed from a Civil War wound—and his party made the complete descent between May 24 and August 29.

The Mountains of California. JOHN MUIR. 1961. Doubleday & Co., Inc., Garden City, N. Y. (Natural History Library, No. 12). 300 pp., 8 plates, 2 maps. $1.25 (paper).

John Burroughs' America. Edited by FARIDA A. WILEY. 1961. Doubleday & Co., Inc., Garden City, N. Y. (Natural History Library No. 13). 293 pp., 8 plates, map. $1.45 (paper).

Contemporary readers are to be congratulated on having available in inexpensive form these ample samples of the writings of two of America's most gifted nature-essayists. The reader must be warned, however, that just as the true beauty of nature cannot be appreciated on the run, so these writings cannot be skimmed or hurried over. Each paragraph, each sentence must be read and savored for its own keen appreciation of natural beauty.

The book by John Muir (1838–1914), first published in 1894, contains many of the essays that originally appeared in *The Century Magazine* and were instrumental in inducing Congress to establish Yosemite and Sequoia National Parks in 1890. The volume by John Burroughs (1837–1921) represents a skillful sampling of his writings first published in 1951. Muir wrote of California and its plains and mountains. Burroughs wrote of the Hudson River countryside. Both made a memorable contribution to America's appreciation of nature.

Biochemists' Handbook. Edited by CYRIL LONG. 1961. D. Van Nostrand Co., Inc., Princeton. 1192 pp.

The aim of this *Handbook* is to present, in concise form factual biochemical information of the most reliable kind primarily for research biochemists, but likewise for workers in related fields. It is organized in six parts: (1) Chemical Data, (2) Data of Individual Enzymes, (3) Metabolic Pathways, (4) Chemical Composition of Animal Tissues, (5) Chemical Composition of Plant Tissues, (6) Physiological and Nutritional Data. One hundred seventy-one persons have contributed to the book, and a four-page table of contents and a 64 page index provide an entrée to its contents.

The Journal of Theoretical Biology. Edited by J. F. DANIELLI (Zoology Department, King's College, Strand, London W.C.2, England). Vol. 1, No. 1, Jaunary, 1961. Academic Press, London (17 Old Queen Street, S.W.1). $17.00 ($12.00 to individuals).

This journal has been established for theoretical work in all fields of biology. It is essential that the major part of contributions be readily intelligible to all biologists, so that mathematical development should be confined to appendices and all specialized terms be defined. The first issue contains eight papers on subjects pertaining to biochemistry, cell physiology, biophysics, "organismic law," and theoretical ecology.

Models and Analogues in Biology. Edited by J. W. L. BEAMENT. 1960. Academic Press, Inc., New York. 255 pp., illus. $9.50.

This is the Fourteenth Symposium of the Society for Experimental Biology held at the University of Bristol, September 6–12, 1960. It consists of 18 essays which discuss in technical terms a very basic aspect of scientific method. "Models" are verbal or mathematical or mechanical formulations by means of which the attempt is made to further our understanding of aspects of the world. Their nature, use, value, and limitations in different fields are among the subjects discussed in this book.

Partition of Cell Particles and Macromolecules. PER-AKE ALBERTSSON. 1960. John Wiley and Sons, New York. 231 pp., illus. $7.00.

This book, a doctor's thesis prepared at the University of Uppsala, presents a new method for the fractionation of particles and macromolecules of biological origin. This involves distribution in two-phase systems specially constructed to allow a gentle treatment of fragile biochemical substances such as cell particles, viruses, microsomes, enzymes, and nucleic acids.

Explorations into the Nature of the Living Cell. ROBERT and EDWARD L. CHAMBERS. 1961. Commonwealth Fund—Harvard Univ. Press, Cambridge, Mass. 352 pp. $8.00.

At last we have a comprehensive review of what has been and can be learned by the use of micromanipulators, an instrumental approach to the nature of the living cell developed most fully by the late Robert Chambers. For his contributions to the subject the elder Chambers is granted co-authorship of this substantial volume which is also a tribute to the father by his son. Aspects of the cell explored by the method include: physical states of protoplasm; extraneous cell coats and intercellular cement; the protoplasmic film or cell membrane, with an hypothesis regarding its composition, and significance of the integrity of the nuclear membrane; direct action of injected salts on cytoplasm; pH of cell components determined by microinjection of indicators; vital staining and penetration of dyes; the nature of mitosis and cell division; and amoeboid movement. In addition to a careful discussion of these topics, the author gives us a practical guide to the instrumentation and techniques of micromanipulation, an accurate history of their development, a bibliography of the works of Robert Chambers and his associates as well as supplementary references and abundant illustrations.

Occasionally the author refers to results from manipulations of cells by hand and this serves to remind us that such observations must be legion, though often ancillary to other inquiries. One recalls the compression and hair-noosing of eggs by Boveri and Spemann, Jennings' sprinkling of carbon particles on the amoeba pellicle, the drawing of cells and unicells into capillary tubes, countless effects of simple exposure of cells to various solutions or radiations (excluding Heilbrunn's ill-starred attempts to measure protoplastic viscosity by this method, which is fairly criticized by Chambers), etc., all contributing to the types of information about the cell expounded in this volume. Yet the task of bringing together all these scattered and

buried complemental data would be almost impossible. Chambers does well to confine his review largely to studies with the mechanical micromanipulator on the living cell, providing a capable and very worthwhile summary of this field at a time when its findings may well be reconsidered in relation to those of biochemistry and electron microscopy.
—Vance Tartar

Mathematical Biophysics, Physico-Mathematical Foundations of Biology. N. RASHEVSKY, 3rd edition. 1960. Dover Publications, New York. xxxviii + 950 pp. 2 vols., paperbound. $5.00.

This work is not merely an economical reprint but a new revised and enlarged edition of Rashevsky's bold and ingenious attempts to devise mathematical models, based on physical principles, which may prove applicable to biological phenomena ranging from the crawling of snakes to abstract thought and esthetic appreciation. Other topics so treated include cell growth and division, the cancer problem, development and nature of organic forms, nerve action, the central nervous system, locomotion of animals, integration and variety of organisms expressed by topology, geometrization of biology, and the organic world as a whole. Therefore we have here the preliminary outline of a theoretical biology based on mathematical biophysics. The method of erecting mathematical models is that which has proved so powerful in physical science and naturally, with these high credentials, one hopes for equal success in its application to biology. Biologists generally cannot fail to be stimulated by the possibilities for formalizing and simplifying the problems of their fields, once they have caught the spirit of this approach.—Vance Tartar

Mathematical Principles in Biology and Their Applications. NICHOLAS RASHEVSKY. 1961. Charles C Thomas, Springfield, Ill. 128 pp. $6.00.

This book is an exposition of some of the ways in which mathematics may be applied. It is addressed to those biologists and physicians who have a general knowledge of mathematics but who are not sufficiently at home with it to read the more technical publications in this field and may perhaps serve as a useful introduction to the same author's *Mathematical Biophysics*, noticed immediately preceding this.

The introductory sections of the several chapters present a delightfully informal account of the role of mathematics in biology. Examples for elementary mathematical development are taken from the role of diffusion in cells, the functioning of the nervous system, the general morphology of plants and animals, and biological "epimorphism."

Tools of Biological Research Vol. II. Edited by HEDLEY J. B. ATKINS. 1960. Charles C Thomas, Springfield, Ill. 175 pp., illus. $8.00.

Initiated by two symposia on the title subject, this handbook by British authorities provides concise introductory accounts of the theory, instrumentation, methods, and results of the following research tools: electron spin, resonance spectroscopy, electroencephalography, paper chromatography, the ultracentrifuge, X-ray studies in biological research, fluorescent antibody techniques, phonocardiography, vectorcardiography, the cathode ray oscillograph and its application to electromyography, and microradiography.—Vance Tartar

Microbial Reaction to Environment, The 11th Symposium of the Society for General Microbiology. Edited by G. G. MEYNELL and H. GOODER. 1961. Cambridge Univ. Press, New York. 416 pp., illus. $7.00.

Commencing with a chapter on feeding, metabolism and other responses of protozoa with particular regard to possible origins of metazoan responsiveness, various authors discuss the effects of environment on the form, structure, activity, behavior, enzymes, synthesis, radiation sensitivity, genetic recombination, antibiotic production, chemical composition, infection, and immunology of viruses, bacteria, aquatic fungi and molds. These changes range from the production of a single protein to those such as sporulation and synchronous division which affect the whole organism. Covering extensive bibliographies, this collection of up-to-date reviews should be indispensable to microbiologists.—Vance Tartar

Introduction to Soil Microbiology. MARTIN ALEXANDER. 1961. John Wiley & Sons, Inc., New York. 472 pp., illus. $9.50.

Among the most fundamental and important of all biological processes are those accomplished by the microflora of the soil in keeping those elements essential for the life of green plants and animals in circulation. Without their continuous operation life of any sort on the earth would be impossible. The book is a treatment of the ecology, general classification, and detailed biochemistry of these processes. The median 225 pages of the book tell of the all-important carbon and nitrogen cycles. The circumstances connected with phosphorus, sulfur, iron, potassium, manganese, and a few other elements are treated in less detail. The bibliographic references at the end of the chapters are divided into two categories: "reviews" and "literature cited." A basic biological book.

Studies in Paleobotany. HENRY N. ANDREWS, JR., with a chapter on palynology by CHARLES J. FELIX. 1961. John Wiley and Sons, New York. 487 pp., illus. $11.75.

This is a well-done introductory textbook on fossil plants designed for advanced students of botany and geology. From it the student may learn about the structure and geological distribution of the major types of vascular plants, the taxonomic and evolutionary problems that they present, and the major features of a selected series of fossil floras. The Anthophyta (Angiosperms) are considered in less taxonomic detail than some of the other groups, but a chapter is devoted to some Tertiary European and western United States floras. There are numerous accounts of plants of very uncertain relationships.

The word "studies" in the title is well chosen because the author provides not a cut-and-dried encyclopaedic account of paleobotany but a selection of the aspects of the subject that interest him. The basic principle to be kept in mind in all fossil studies is the tremendous incompleteness of the geological record—an incompleteness that, paradoxically, becomes more evident the more numerous become the fossils that are found and described. In paleobotany this is apparent not only as the discovery of new forms and new floras reenforces our awareness of how little after all we really know but likewise as the absence of reproductive parts from many of the fossils keep us from understanding the relationships of the plants that we do find. The situation is analogous to that in the fossil beetles in which the impressions of the beetles in the rocks tell us little about their exact relationships.

Intermediary Metabolism in Plants. DAVID D. DAVIES. 1961. Cambridge University Press, New York. 108 pp., 35 figs. $4.00.

A brief but lucid outline of the concepts and theories of intermediary metabolism (in plants), using specific examples only to avoid becoming lost in generalizations. Topics chosen for discussion represent an arbitrary selection, the two major omissions being photosynthesis and nucleic acid metabolism. Bibliography.

Trace Elements in Plants. WALTER STILES. 1961. Cambridge University Press, New York. 249 pp., 16 plates. $7.50.

This is the third edition of what was formerly (1946, 1951) issued as *Trace Elements in Plants and Animals.* The major trace elements concerned are manganese, zinc, copper, molybdenum, boron and sometimes chlorine. Except the last two, these seem to be involved in enzymes playing a part in photosynthesis.

This book treats of the various aspects of trace-element deficiency and excess in plants. A penultimate chapter treats of selenium and molybdenum poisoning and cobalt deficiency in grazing animals. Full bibliography.

The Plant Community. HERBERT C. HANSON and ETHAN D. CHURCHILL. 1961. Reinhold Publishing Corporation, New York. 218 pp., illus. $4.95.

This book is intended as a text for semester or quarter courses in plant ecology. It deals with species and their grouping into communities and the various ways in which communities are related spatially and in time. Much attention is given to the effects of the grazing of domestic animals on plant communities and passing reference is made to other animals, such as insect pollinators. The effects, however, of destructive outbreaks of insects is not considered at any length. A strong feature of the book is the excellent photographs of plant communities in many parts of North America. Extensive bibliography.

How to Know the Ferns, A Guide to the Names, Haunts, and Habits of our Common Ferns. 2nd edition. 1961. FRANCES THEODORA PARSONS. Dover, New York. 215 pp., illus. $1.25.

Reprinted from the original 1899 edition, this guide provides the information and preserves that charm of less hurried times appropriate for people with a hobby interest in ferns. Following a simple key and general discussion of ferns, 57 species are identified and illustrated in habitus and detail, with an appreciative account of each. Although particularly suitable to the northeastern states, most genera are nevertheless represented throughout the country.—Vance Tartar

General Biology. WILLIAM T. TAYLOR and RICHARD J. WEBER. 1961. D. Van Nostrand Co., Inc., Princeton. 945 pp., illus.

General Biology. WILLIS H. JOHNSON, RICHARD A. LAUBENGAYER, and LOUIS E. DE LANNEY. Rev. ed. 1961. Holt, Rinehord and Winston, New York. 655 pp., illus. $7.95.

Introductory Botany. ARTHUR CRONQUIST. 1961. Harper & Bros., New York. 892 pp., illus. $9.25.

Integrated Principles of Zoology. CLEVELAND P. HICKMAN. 1961. C. V. Mosby Co., St. Louis. 972 pp., 639 figs. $7.75.

Each of these four volumes is an attractive, competent introduction and each will undoubtedly have many satisfied users. If they are somewhat formidable as to length, it is only evidence of the continued growth of biological science and the need that surveyors of the field are under of superimposing the newer molecular biology on the older morphology and physiology. Of the four, the *Botany* is, perhaps, the most conventional and Taylor and Weber's *Biology* and Hickman's *Zoology* the most comprehensive, with Johnson, Laubengayer, and De Lanney's *Biology* provided with some of the most suggestive figures. The *Botany* concludes with a nice key to the orders and higher groups of plants. Each of the books gestures in the direction of molecular biology, but the reviewer feels that none of the authors have really succeeded in making this material intelligible to persons without previous preparation in biochemistry.

Animal Ecology. W. H. DOWDESWELL. 1961. Harper & Bros., New York. 209 p., 61 figs. $1.50.

This is a brief and rather formal survey of the interrelationships of animals with their environment and with each other. The principal communities—terrestrial, marine, and fresh water—as present in Great Britain are reviewed, and most of the examples are British. It is a reprint of the second edition published in 1959.

The Cell and the Organism. Essays Presented to Sir James Gray. Edited by J. A. RAMSAY and V. B. WIGGLESWORTH. 1961. Cambridge University Press, New York. 350 pp., illus. $9.50.

This is a collection of 20 essays by members and former members of the Department of Zoology at Cambridge University on various topics related to experimental zoology. They have been issued in honor of Sir James Gray, who, in the period following 1928, did much to wean zoology at Cambridge away from its too exclusive concern with problems of evolutionary morphology. They range from the study of individual cells, the mechanism of ciliary action, and the movements of spermatozoa to the functional morphology of lugworms, myriapods, and electric eels.

One of the most delightful of the essays is by L. E. R. Picken, who reminds us that "only those who are inescapably attracted by animals as animals know what it is to be a zoologist . . . The field of 'zoology' now includes many highly gifted individuals, who are not zoologists. . . . The biologist must beware of transferring allegiance wholly to hero-figures of biophysics and biochemistry. . . . Botanists and zoologists do not differ from biochemists, biophysicists, and physiologists, merely as the result of an accident of early training; they are different kinds of people. It would be uneconomic to reject the potential services to mankind of the zoophilous zoologist."

Growth, Development, and Pattern. N. J. BERRILL. Freeman, San Francisco. 555 pp. 252 figs. $10.00.

Since morphogenesis poses the most difficult as well as the most intriguing problem in biology, we have to approach a solution through multiple, personal orchestrations of pertinent data to which good minds have devoted their best thoughts, keeping close to the empirical until theoretical insight is at last achieved. This book is such a rendering and likewise a summing up of a life-time's careful study by the distinguished McGill zoologist. Like C. M. Child, Berrill seeks clues to development in lower forms rather than in the more conventional experimental embryology of echinoderms and vertebrates. Especially outstanding are descriptions of the amazing things that coelenterates, worms of several phyla, and tunicates do in development, growth and regeneration; for much of this account is first-hand observation by the author. Yet correlations with morphogenetic studies on unicellular forms and the more familiar embryogenesis of eggs is not neglected. Moreover, and unique for a work of this kind, plant morphogenesis is summarized for its arresting parallels with the development of colonial animals.

The types selected—Acetabularia, Stentor, Dictyostelium, Volvox, Hydra, certain medusae, tubularians, flatworms, polychaetes, and tunicates, etc.—are presented with sufficient detail and reference documentation to make this a meaty supplementary text for courses in embryology. Deliberately contributing to this end and to general clarity is the series of 252 excellent drawings, examining developments down to histological details and therefore showing exactly what is going on. Yet in one chapter Berrill achieves a remarkable set of first-order generalizations unifying his most varied material and suggestive of future theories of morphogenesis. The direction he expects such explanations to take eventually would postulate a cell-surface pattern capable of evolving a trans-cellular cortical network, necessarily supplementing biochemical and genetic analysis, intimately correlated with growth, and guiding the otherwise completely mysterious transformations in development and regeneration of organic forms.

—Vance Tartar

Advances in Morphognesis, Vol. 1. Edited by M. ABERCROMBIE and J. BRACHET. 1961. Academic Press, New York. 445 pp., illus.

This is the first volume of a proposed series which the editors say will attempt to link up the various branches of biology dealing with development. They consider within the scope of the series any studies of new formation or of the remodeling of living material. Volume 1 contains nine reviews: I. "A Chemical Approach to the Problem of the Organizer," by Tuneo Yamada. In addition to a review of the recent advances in biochemical aspects of embryonic induction, this chapter includes a description of subcellular components of amphibian cells and their possible role in induction and differentiation. II. "The Embryology of Ascidians," by G. Reverberi. Presents material dealing with the biochemical constituents of the egg, their segregation during development, their biological significance, and their interactions in morphogenesis. III. "Regeneration of Vertebrate Appendages," by R. J. Goss. Includes phylogenetic aspects of regeneration and a description of the process in addition to a review of the experimental work in the field. IV. "Action of Morphostatic Substances and the Role of Proteases in Regenerating Tissues and in Tumour Cells," by F. E. Lehmann. Reviews work that seems to demonstrate that systematic inhibition of regenerating tissue and tumor cells is possible by combinations of morphostatic substances, and discusses possible relationships with protein metabolism. V. "Determining Factors in Cell Growth: Some Implications for Morphogenesis in Plants," by F. C. Stewart and H. Y. Mohan Ram. Review of experiments which indicate that an array of regulatory substances furnished by special tissues or secreted by localized centers of stimuli may exercise control over responses of cells and that these controls override the genetic effects. IV. "The Differentiation of Vertebrate Pigment Cells," by Charles E. Wilde, Jr. A discussion of normal pigment cell development and differentiation and an analysis of current work in the study of vertebrate pigment cells. VII. "Limb Morphogenesis," by Edgar Zwilling. A discussion of recent information about mechanisms important in the morphogenetic processes involved in limb morphogenesis. VIII. "Morphogenesis of the Vertebrate Eye," by G. V. Lopashov and O. G. Stroeve. Summarizes results of experiments on the development of the eye and outlines some pathways for further advance. IX. "Structural and Dynamic Aspects of the Development of the Teleostean Egg," by Ch. Devillers. A review of experimental studies of egg organization, its physico-chemical characteristics, and the preparation of the structural elements and the dynamic properties that are brought into play by gastrulation.

The articles are more or less centered around the respective authors' work with a review of the pertinent research of others. The diversity of topics included in this volume and the form in which they are presented make it an excellent unit for any reader interested in developmental biology.—Alex Haggis.

Evolution Above the Species Level. BERNHARD RENSCH. 1960. Columbia University Press, New York. 419 pp., 113 figs. $10.00.

This splendid book is an important elaborate fully documented statement of what has come to be the orthodox evolutionary theory of such men as R. A. Fisher, Julian Huxley, Theodosius Dobzhansky, Ernst Mayr, and George Gaylord Simpson. If it seems an oft-told tale, however, we should remember that it was the author of this book, the German, Bernhard Rensch' who was one of the most important founders of this orthodoxy. The volume is a translation by Dr. R. Altevogt of the second edition of the author's *Neuere Probleme der Abstammungslehre* published in 1954.

Aside from its main import, Rensch's books bring us in touch with a mass of German literature only scantily referred to by British and American writers. Moreover, the wealth of examples Rensch cites puts us in touch with a naturalist that loves animals for their own sake and not simply as subjects for experimentation. The reader, however, should be warned about Chapter 10, The Evolution of the Phenomena of Consciousness. Rensch is an eminent zoologist, but as a general philosopher, he just does not rate—at least in the opinion of this reviewer.

Principles of Animal Taxonomy. GEORGE GAYLORD SIMPSON. 1961. Columbia University Press, New York. 247 pp., 30 figs.

This is a detailed and highly philosophical discussion of the logic involved in animal classification. It is a book that deserves the most careful study by every worker in the field of taxonomy. The author's chief adversary is the "typologist" whom he never tires of belaboring for almost all the ills that taxonomy is heir to! A strength as well as a limitation of the book is that Simpson is a mammalogist. The abundant fossil record of the mammals gives an unexcelled basis for the consideration of the role of phylogeny in classification, but the same circumstance as well as the small number of mammal species prevents much consideration of the special taxonomic problems in a large group like the insects with its scanty fossil record. It is likewise without the scope of the book to give much attention to the practical problems that the taxonomist meets. Simpson refers several times to the fact that taxonomy is an art as well as a science, but does not explore the implications of this fact or consider the practical problems that the practitioner of the taxonomic art encounters.

The Littoral Fauna of the British Isles, A Handbook for Collectors. Ed. 3, 1961. N. B. EALES. Cambridge University Press, New York. 306 pp., 111 figs. $6.50.

This is the third edition of a collector's handbook first issued in 1939. It consists of keys, short descriptions, and a brief bibliography of the larger and more common species inhabiting the littoral zone in the British Isles. Reliance is placed on keys and descriptions for identification and the student is continually being referred to the technical literature for the verification of his findings and further information. Introductory and concluding chapters have notes on the littoral associations, the locale of British marine laboratories, methods of collecting and preservation, and glossary. A scientifically conceived and executed introduction to an important fauna.

Culture Methods for Invertebrate Animals. JAMES G. NEEDHAM, PAUL S. GALTSOFF, FRANK E. LUTZ, and PAUL S. WELCH. 1959. Dover Publications, New York. 590 pp., 84 figs. $2.75.

This is a facsimile reprint of this important reference book, first published in 1937. It consists of 313 separate articles by nearly 200 authors on the collecting and laboratory maintenance and rearing of many types of invertebrate animals. Sometimes the same animal (e.g. Amoeba) is treated by several different authors. Although much additional literature has appeared in the 24 years since this book was first compiled, it still should be an important reference for any zoological laboratory in which living invertebrate animals are studied.

Introduction to Parasitology with Special Reference to the Parasites of Man. 10th Ed. ASA C. CHANDLER and CLARK P. READ. 1961. John Wiley and Sons, New York. 822 pp., 258 figs. $9.75.

Since its first publication in 1918, this text of Chandler's under one title or another, has held a prominent place among American books on parasitology. Dr. Clark P. Read, younger colleague of the late Asa Chandler at Rice Institute, has now updated the book, so that it may continue to serve additional generations of college students.

The Biology of Stentor. VANCE TARTAR. 1961. Pergamon Press, New York. 413 pp., 99 figs. $12.00.

Stentor is an interesting genus of 13 species of freshwater ciliate Protozoa. For some years the author of this book has been experimenting on *Stentor coeruleus* Ehr. and other species, culturing them, performing on them a wide range of micrurgical operations, grafting portions of one or several individuals on one another, and in various ways noting how they react to this untoward treatment and how they are or are not able to maintain and restore their structural and functional integrity. In this book he attempts to summarize all that is known about the biology of these animals. Here is an account of their structure and behavior and life history. Well over half the book is devoted to reporting the results of experimental studies in which Dr. Tartar himself has played such a prominent part. The book, however, is primarily a review and not a report on its author's individual researches, although occasional mention is made of unpublished results. The volume may well go far to establishing Stentor as an even more widely used research organism than in the past, and it will be of interest to all students of the morphology, behavior, morphogenesis, life history, and physiology of the free-living Protozoa.

Persons interested in Dr. Tartar's private laboratory at Nahcotta, Washington, where, with the help of grants by the American Cancer Society and the National Institutes of Health, he has made many of the studies reported on in this volume, should consult Dr. Tartar's account of his laboratory in *The Biologist*, Vol. XLI, 1959, pp. 61–64.

Comparative Physiology of Carbohydrate Metabolism in Heterothermic Animals. Edited by ARTHUR W. MARTIN. 1961. University of Washington Press, Seattle. 145 pp., 2 plates. $3.50 (paper), $4.50 (cloth).

This is a series of five reviews of recent literature given before the Western Society of Naturalists in December, 1959. The papers refer to helminth "worms," mollusks, arthropods, fish, and amphibians and reptiles. Publication was made possible by a grant from the Heart Institute of the National Institutes of Health.

Thoracic Cirripedia of the Gulf of California. DORA PRIAULX HENRY. 1960. Univ. of Wash. Publ. in Oceanography 4 (4): 135–158. 5 plates. $1.00.

This is a list of the 16 species, 4 subspecies, and 1 form of barnacles known from the Gulf of California, including detailed notes on 12 species and 1 subspecies taken by Mr. Walter J. Eyerdam in the vicinity of Guaymas in January, 1959. A single new species, *Balanus eyerdami*, is described.

The Ecology and Distribution of the Pseudoscorpions of North-Central New Mexico. C. CLAYTON HOFF. 1959. Univ. of N. Mex. Publ. in Biol. No. 8, University of New Mexico Press, Albuquerque. 68 pp., 5 figs. $1.50 (paper).

An ecological study of the 39 species of Chelonethida or pseudoscorpions so far taken in New Mexico. The paper concludes with a key for the identification of the species and a bibliography.

Insect Life and Insect Natural History. S. W. FROST. 1959. Dover Publications, New York. 526 pp., 406 figs. $2.25 (paper).

This is a reprint of a book first published in 1942 under the title of *General Entomology*. It is a readable middle-level account of many aspects of insect study by an eminent entomologist. Pages 491–493 contain recent bibliography.

Introduction to Entomology. R. JEANNEL, translated by Harold Oldroyd. 1960. Hutchinson, London. 344 pp., 150 figs., 13 plates including six in color. 63 shillings.

This is the translation of a work originally published in Paris in 1945 and 1946. Its importance is that it makes some of the ideas of its eminent author available in English. Dr. R. Jeannel is the Professor (retired) of Entomology at the Museum National d'Histoire Naturelle in Paris and a world authority on Carabidae, Pselaphidae, and Catopidae. He is a long-time advocate of Wegener's theory of the existence in the Paleozoic of Gondwanaland and its fragmentation during the Mesozoic into what is now South America, Africa, India, Australia, and Antarctica. Moreover Jeannel believed that the geological history of insects can be written in these terms. He suggests that Laurentia (now northeastern North America plus northwestern Europe) during the Carboniferous and Permian was equatorial and that in it the Palaeoptera (Palaeodictyoptera, Ephemeroptera, Odonata) and Orthoptera arose. On the other hand, it was in the then temperate Gondwanaland that the Paraneoptera (Thysanoptera, Hemiptera) and the insects with complete metamorphosis originated. "Holometabolism, like homeothermy in the higher vertebrates, ~~is~~ an adaptation that arose under the influence of a temperate climate, with its cold winters." With the end of the Permian, the isolation of Laurentia and Gondwanaland tended to break down somewhat and the world fauna became more mixed. Jeannel suspects that much of present day insect distribution is to be understood in terms of the progressive fragmentation of Gondwanaland during the Mesozoic. The reader is referred to the last hundred pages of Jeannel's book for further details and his classification of fossil and living insects.

One cannot mention Jeannel's scheme of insect evolution without reminding the reader that most geologists do not accept Wegener's hypothesis of moving continents and that such an eminent coleopterist and zoogeographer, as P. J. Darlington, in his book on *Zoogeography* (1957), finds the hypothesis both incredible and superfluous.

Annual Review of Entomology. Volume 6. Edited by EDWARD A. STEINHAUS and RAY F. SMITH. 1961. Annual Reviews, Inc., Palo Alto, Calif. 470 pp. $7.00.

This series has established itself as one of the essential reference and research tools of persons interested in insects. The present volume contains 22 reviews covering a wide range of entomological topics.

The reviewer's purpose in noting this volume here is, however, to animadvert on two methods of writing a review. Sometimes one finds reviews like Kettlewell's delightful essay on "The Phenomenon of Industrial Melanism in Lepidoptera" or like Sasa's "Biology of Chiggers" that read as something to be read ought to read! The material under review has been thoroughly mastered by the reviewer and is carefully organized according to the ideas involved. Subject matter is given emphasis over authors and, while many authors and papers are involved, they are referred to for the most part parenthetically. The reader interested in who did what has no difficulty, but the reader primarily concerned with subject matter can read along without having names continually obtruded upon his attention.

By contrast there is the review that consists of a series of more or less disjointed paragraphs each reporting on a different paper. Brown (21) found so and so. Jones (86) reported such and such. And so on. The aim is to report on the maximum number of papers in the minimum amount of space. This second type of review requires a far less carefully planned architectonic than the first type, is probably a good deal easier to write, and is certainly much more difficult to read. Obviously, many reviews, are intermediate between these two extremes.

This is a plug for more carefully worked out and more readable reviews, even at the expense of more work by the reviewer and less complete coverage by the review.

The Biochemistry of Insects. DARCY GILMOUR. 1961. Academic Press, New York. 343 pp., illus. $8.00.

In this book the author, who is connected with the Division of Entomology in the Commonwealth Scientific and Industrial Research Organization in Canberra, Australia, presents an up-to-date review of the biochemical literature on insects. It is designed as a critical synthesis for use as a teaching text and as a working manual for investigators in insect biochemistry. Over half the book is devoted to energy metabolism, with most of the rest on intermediate metabolism and a final chapter on hormones and morphogenesis. Not only is normal insect biochemistry treated, but numerous aberrant subjects such as anaerobic respiration, light production, and the explosive mixture ejected by bombardier beetles. An unfortunate feature is the omission of titles from the long bibliographies that follow each chapter.

Ten Little Housemates. KARL VON FRISCH, translated by Margaret D. Senft. 1961. Pergamon Press, New York. 146 pp., illus. $3.00.

This is a translation of the fourth edition of the author's *Zehn Kleine Hausgenossen* of 1955. It "is not meant to be either an encyclopedia or a textbook", but "to give some information concerning small housemates whose names are quite familiar although little else is generally known about them" and "to show that there is something wonderful about even the most detested and most despised of creatures" (p. 141). Flies, gnats, fleas, bedbugs, lice, clothes moths, cockroaches, silverfish, spiders, and ticks are the creatures treated. A delightful book, but the accounts are bowdlerized to the extent that mating habits are passed over in silence!

The Social Insects. O. W. RICHARDS. 1961. Harper & Bros., New York. 219 pp., 63 figs. $1.50.

A corrected edition of a book first published in 1953, this book by an eminent British entomologist is a refreshing review of the subject so ably surveyed by William Morton Wheeler in 1923 in his *Social Life Among the Insects.* Readers of the older book will be especially interested in Richard's reference to the social habits of some of the British bees of the genus Halictus and his account of the perennial societies of some of the tropical wasps. It appears that the annual societies of temperate zone wasps and bumble bees may be an adaptation of tropical forms to temperate conditions. The book lacks detailed documentation, but contains a page of further readings.

Dwellers in Darkness. S. H. SKAIFE. 1961. Doubleday & Co., Inc., New York (Natural History Library No. 9). 180 pp., 16 plates, 26 figs. 95¢ (paper).

This is an interesting, detailed account of the life history and ecology of the Black-Mound Termite (*Amitermes atlanticus* Fuller) of the Cape of Good Hope. These termites live in hemispherical termitaries which may attain a height and diameter of about two feet. They have reproductive, soldier, and worker castes and have a dietary rather limited to the decayed stems of the reedlike plants of the family Restionaceae. Their termitaries are rather easily removed to the laboratory. The book tells of the colony founding, nest building, brood rearing and other habits of the insects; it gives an account of their guests, parasites, and predators; and concludes with a short list of general readings on termites.

A Manual of Common Beetles of Eastern North America. ELIZABETH S. and LAWRENCE S. DILLON. 1961. Row, Peterson and Company, Evanston, Ill. 884 pp., 544 figs., 4 colored and 81 black and white plates. $9.50.

This book keys, describes and figures nearly 1200 of the 10,000 species of North American beetles living east of the 100th meridian. The authors feel that the species have been so selected that "the student should be able to identify to species the vast majority of specimens he collects, and a large number of others to genus or family." Introductory chapters treat of methods, structure, larvae, and ecology. A nine page glossary, a 52 page bibliography, and index conclude the book. The bibliography arranges the literature by families and states, the latter listing being particularly useful to students of restricted faunas.

The only other book comparable to this one is Jaques' *How To Know The Beetles,* 1951. Jaques' book keys and/or mentions about 1500 species, of which some 900 are figured, but contains no bibliography and only a very brief introduction. Moreover, Jaques' larger number of species is "diluted" slightly by the inclusion of occasional western North American forms. Jaques inevitably, despite the lesser number of his figures, illustrates many species that the Dillons do not.

Both these books belong to that very large class of natural history guides which treat of only selected species in their fauna. As long as that is kept firmly in mind, only enlightenment can come from their use, and many persons interested in only a slight or passing knowledge of the groups they cover—beetles in this instance—will find their interests satisfied. But precise identification by persons inexperienced in the study of the groups covered cannot be made from books of this sort and inevitably, or so it seems to the reviewer, the critical user of this type of literature will quickly go on to something that he can employ with more certainty because it treats of all or nearly all the forms that occur in his region. Thus books of the Dillon and Dillon and of the Jaques type will see only transitory service in the hands of the serious student or, at most, if such a student does go back to them, it will be as a convenient or even a unique source of a figure of a particular species or to recall to mind the precise name of a species already known to him.

In conclusion, the Dillons are to be congratulated on the publication of a beautiful and useful set of figures. One error, however, is to be detected. The author of *Melanophthalma distinguenda* (p. 425) was not the American Comstock, but the Italian Antonio Comolli.

Bionomics, Systematics, and Phylogeny of Lytta, a Genus of Blister Beetles (*Coleoptera, Meloidae*). RICHARD B. SELANDER. 1960. Illinois Biological Monographs 28. University of Illinois Press, Urbana. 295 pp., 350 figs. paperbound, $4.50; clothbound, $5.50.

Lytta is a genus of more than 88 medium to large sized beetles, the adults of which occur, frequently in numbers, on the flowers and sometimes the leaves of many plants throughout Eurasia and North America. In common with other members of the family, the larvae undergo a hypermetamorphosis, preying in this genus on the stored pollen in the nests of solitary bees mainly of the family Anthophoridae. The most famous member of the genus is the Palaearctic *Lytta vesicatoria* L., the dried bodies of which have long been used in the preparation of the vesicating agent, cantharides.

The present monograph treats the classification of the adults and the habits of the 68 species of the genus found in North America north of Panama. The group is generally distributed over the continent from southern Canada south. Thirty-two of the species occur in California, 27 in Mexico. Seven occur in the Pacific Northwest and only four east of the Mississippi River. Keys, both artificial and phylogenetic, are provided to the species, and phylogenetic keys to the subgenera, species groups, and species subgroups.

Dr. Selander does not recognize as nameable any categories below the rank of species, relegating both aberrational and geographic race names to absolute synonymy. Moreover, he attempts to organize his subgenera and species groups according to what he believes to be the phylogenetic relationships. The result is that many of these become virtually undefinable in any very simple terms. Dr. Selander has not originated any of these tendencies. Whether they are mere fads or actually represent the wave of the taxonomic future only the course of events can disclose.

Forest and Shade Tree Entomology. ROGER F. ANDERSON. 1960. John Wiley & Sons, Inc., New York. 428 pp., illus. $8.50.

An elementary text book of forest entomology for use in the United States and Canada. Following a 92 page introduction, the various important insects are passed in review, classified according to the portion of the tree attacked. Most of the illustrations are from photographs.

Biological and Chemical Control of Plant and Animal Pests. Edited by L. P. REITZ. 1960. Publ. 61, Amer. Assoc. for the Adv. of Science, Washington. 285 pp., 11 illus. $5.75.

This is the report of a symposium presented by Section O on Agriculture at the Indianapolis meeting of the American Association for the Advancement of Science, December 28–30, 1957. The book consists of 19 papers. The first five of these are short and general. Some of the later ones, however, consist of reviews with extensive bibliographies: "Fungicides and Bactericides for Controlling Plant Disease" (by G. L. McNew), "Chemical Weed Control" (R. H. Beatty), "Organophosphorus Systemic Insectides" (J. E. Casida), "Chemical Control of Internal Parasites of Domestic

Animals" (F. O. Gossett), the activity of one organism against another in the control of plant disease (W. C. Snyder), "Pathogens for the Control of Pests" (J. D. Briggs), "Control of Screwworm Fly by Atomic Radiation" (E. F. Knipling), "Parasites and Predators for Pest Control" (C. A. Fleschner), "Disease Resistance in Animals" (N. F. Waters), and three reviews on breeding plants for resistance to disease and insects.

The Genesis of the Mouse Skeleton. A Laboratory Atlas. ZOLTON T. WIRTSCHAFTER. 1960. Chas. C Thomas, Springfield, Ill. 169 pp., 83 plates. $11.75.

This is a companion volume to the author's *Genesis of the Rat Skeleton* published in 1957. In a series of 43 plates of photographs, the development of the mouse's skeleton is traced from the 14th to the 38th days after conception. This is followed by 7 plates depicting the development of the skull and 24 plates tracing the development of the skeleton of the limbs. The specimens, before photographing, were macerated and cleared in a dilute aqueous solution of potassium hydroxide, stained in Alizarin Red-S, and photographed in a glycerine and potassium hydroxide solution. The first appearance only of each center of ossification is labeled. The book "furnishes a 'norm' against which abnormalities induced in the course of experimentation can be measured and assayed."

Vertebrate Biology. ROBERT T. ORR. 1961. W. B. Saunders Co., Philadelphia. 400 pp. $7.50.

An attractive survey of vertebrate biology with primary reference to the fauna of the United States. The vertebrate classes are surveyed in about 150 pages followed by chapters on systematics, distribution, territoriality, migration, hibernation, reproduction, development, and population dynamics. Bibliographies follow each chapter.

Animal Vision. What Animals See. R. H. SMYTHE. 1961. Chas. C Thomas, Springfield, Ill. 250 pp., 102 figs.

A popularly written book on animal vision by a veterinary surgeon. Only cursory mention is made of animals other than vertebrates. No bibliography.

Galapagos: The Noah's Ark of the Pacific. IRENAUS EIBL-EIBESFELDT. 1961. Doubleday and Co., Garden City, N. Y. 192 pp., 4 colored and 28 black and white illustrations. $3.95.

This book, translated from the German by Alan Houghton Broderick, is a very readable account of some of the more striking animals of the Galapagos Islands, based on visits to the archipelago in 1954 and 1957. Sea-lions, tortoises, iguanas, cormorants, Darwin's finches, *Homo sapiens* L. and others come in for non-technical but authoritative treatment. The book concludes with a glossary of the scientific names of the animals mentioned and a bibliography.

One is aghast as the author depicts the senseless and ruthless slaughter by man of the islands' original inhabitants. Dr. Eibl-Eibesfeldt has succeeded in founding a "Charles Darwin Foundation for the Galapagos Islands" which is preparing to establish an international research station in the archipelago as well as effectively guarded nature preserves where the peculiar and unique fauna of the islands will be protected. One cannot, however, help wishing that these barren volcanic islands, so unsuited for human occupancy, had as a whole and from the very beginning been made a biological sanctuary!

Readers of this book are reminded that pages 16–39 of *Life* Magazine's *Wonders of Life on Earth* (1960) treat of these islands with striking colored pictures of some of their inhabitants. Dr. Eibl-Eibesfeldt was one of the members of the expedition *Life* sent to the islands.

Living Fishes of the World. EARL S. HERALD. 1961. Doubleday and Co., Garden City, N. Y. 304 pp., 145 colored and 155 black and white figures. $12.50.

This is one of a series of similarly splendidly illustrated books of which others have treated of mammals, birds, reptiles, insects, and the lower invertebrates. The colored illustrations, reproduced from colored photographs, occupy five 16-page sections. The arrangement of the book is by families. It is at a general non-technical level, but the fact that its author is curator of the Steinhart Aquarium in San Francisco assures its authenticity. The individual treatments are brief, but the non-ichthyologist will find mentioned most of the fishes he has heard about. The book concludes with an illustrated glossary and a short bibliography. Students of fishes will find it interesting as well as general lovers of nature and persons building natural history libraries for schools and young people.

Bird Study. ANDREW J. BERGER. 1961. John Wiley and Sons, New York. 389 pp., illus.

The emphasis in this attractive book is on the significance of and the methods involved in the field study of birds. The examples discussed are drawn almost exclusively from the North American fauna. The eleven chapters treat such topics as field identification, habitats, migration, behavior, song, courtship, mating, nest building, eggs and young, and conservation. Single chapters likewise consider the morphology and physiology and birds and their systematics. There is a list of the orders and families of North American birds and an alphabetical list of common names with the scientific name (but without author's name) of each. A general bibliography arranged by chapters concludes the book.

New Mexico Birds and Where to Find Them. J. STOKLEY LIGNON. 1961. The University of New Mexico Press, Albuquerque. 360 pp., 35 colored plates, illus. $8.50.

This is an annotated descriptive catalogue of the 394 species of birds found in New Mexico. Of these 149 are illustrated in color and 139 in black-and-white. An introduction gives the history of the study of New Mexican birds with brief biographies and portraits of the ten outstanding contributors. An appendix gives 15 or 20 lists of birds from different portions of the state, including a number of Christmas bird counts. All in all, this book should find a welcome place in the library of naturalists in the Southwest and of ornithologists everywhere. No bibliography.

The Wandering Albatross. WILLIAM JAMESON. 1961. Doubleday & Co., Inc., New York (Natural History Library No. 6). 131 pp., 8 plates, 6 figs., 2 maps. 95¢ (paper).

The reviewer's introduction to the albatross was through the medium of Coleridge's *Rime of the Ancient Mariner* and the illustrations by Gustave Dore. The present book reveals, however, that any ill or good omen connected with a ship being accompanied by an albatross was compounded out of whole cloth by Coleridge and Wordsworth during a walking tour in the fall of 1797. The poem appeared the following year.

The present book by Admiral Sir William Jameson of the British Navy is a straight forward account of the habits and life history of the Wandering Albatross (*Diomedea exulans* L.). The author's direct experience with the bird was confined to observations of its soaring flight while accompanying a ship, but he compiles competently from those who have recorded its breeding habits on various Antarctic islands. The single chick does not leave the nest until about a year after the egg from which it hatched was laid, so that breeding occurs only every other year. This is a reprint of the revised edition of a book originally published in 1958. Full bibliography.

Shearwaters. R. M. LOCKLEY. 1961. Doubleday & Company, Inc., New York (Natural History Library No. 4). 256 pp., 7 figs., maps. $1.25 (paper).

This is a detailed report of the author's investigations into the life history and habits of the Manx Shearwater (*Puffinus puffinus*) on Skokholm Island off the southwest corner of Wales in the years 1929 to 1939. In a style reminiscent of the famous Jean Henri Fabre, Lockley gives us an account of his research, beginning with the behavior of the mated pair in the burrow in which they nest and ending with his studies into the homing ability of marked individuals. A fascinating and informative book. No bibliography.

Darwin's Finches. An Essay on the General Biological Theory of Evolution. DAVID LACK. 1961. Harper & Bros., New York. 204 pp., illus. $1.40.

This book is a detailed non-technical account of the taxonomy, ecology, distribution, and evolution of Darwin's finches in the Galapagos Islands. These islands are so frequently mentioned in discussions of evolution that many persons must have been led to wonder what it is all about. This book, first published in 1947, is the place to go to find out. As its author points out in a new introduction, the book seems to have played a role in convincing biologists that "all, or almost all, subspecific and specific differences are adaptive." Evolutionists, taxonomists, ecologists, Darwinists, ornithologists, zoogeographers, and Galapagos Islands fans should all be interested in this charming volume.

Techniques for Determining Age of Raccoons. GLEN C. SANDERSON. 1961. Ill. Nat. Hist. Surv. Div., Biol. Notes No. 45, 16 pp., 8 figs.

Single copies of this paper may be had free on application to the Section of Wildlife Research, Illinois Natural History Survey, Urbana, Ill.

Physiology of Reproduction and Artificial Insemination of Cattle. G. W. SALISBURY and N. L. VAN DEMARK. 1961. W. H. Freeman & Co., San Francisco. 639 pp., illus. $12.50.

Since the introduction of artificial insemination of cattle on a practical scale in the late thirties, the practice has spread so that, in 1959, 6,932,294 cows were so inseminated with semen collected from 2,460 bulls, or an average of 2,816 cows per bull. This book provides the embryological, physiological, biochemical, and technical background and details for the use of operators of stud farms, animal husbandrymen, veterinarians, and dairymen. Perhaps those chapters that will most interest the non-professional are Chapters 13 and 18, which deal with the collection of semen from the bull and its use in inseminating the cow. An attractive well-illustrated book with very extensive bibliography.

Animal Husbandry Heresies. ALLAN FRASER. 1961. Philosophical Library, New York. 200 pp. $6.00.

The author of this book is a lecturer in Animal and Dairy Husbandry at the University of Aberdeen. As the title suggests, he is somewhat unorthodoxly skeptical of some of the current notions of heredity and management of farm animals, but what it seems to simmer down to is that husbandrymen should remain ever alert to new methods and that the proper management of stock is as important as its heredity. The author's specialty is sheep, but cattle and, to a less extent, pigs and poultry are referred to and the British scene is foremost in his mind.

As exemplifying the author's charming style, the description of shepherding in the Near East may be quoted (p. 151). "The sheep were never driven. They were *led* . . . The flock would be safely grazing on the fresh spring pasture of the Palestinian hills. When they had been there some time, the shepherd would play a monotonously wistful air upon his pipe, the bell-wether would walk slowly toward him, its bell tinkling melodiously and then, very gradually, gently and peacefully, the whole flock would gather together to follow their shepherd to pastures new. The practice struck me as being not merely poetic but rational. The sheep having grazed, suffered no disturbance, alarm or interruption of rumination on being gathered. Full of pasture they slowly walked but never ran. They never overgrazed one area of pasture because the shepherd controlled their grazing. They moved to fresh pasture, willingly at his musical bidding, leaving their excrement and parasites behind. The dogs that accompanied the shepherd, savage wolf-like creatures commanding respect, were there to guard the sheep but not to drive them."

Horses. GEORGE GAYLORD SIMPSON. 1961. Doubleday & Co., Inc., New York (Natural History Library No. 1). 323 pp., 32 plates, 27 figs. $1.45 (paper).

This is a popular but relatively detailed account of horses by an eminent authority on their fossil history. Part One (pp. 1–110) is a general account of living horses. Chapter 4, "Horses and History" is relatively superficial and would have been improved by a consideration of the relation of the horse to those more ancient beasts of burden, the ass and the ox, and by a more penetrating account of the horse's past role in war and in communication.

Beginning with their condylarth ancestors in the Paleocene, Part Two follows out the various modifications and radiations of the horse line as well as those of several extinct and living horse relatives. The charts of horse evolution on pages 148 and 202 are especially illuminating. While in no sense a technical treatise, the book well serves as a source book for anyone short of a specialist on fossil mammals desiring information on fossil horses.

The book is a reprint of a work originally published in 1951, but a 1961 preface by the author points out recent developments. The horse population of the United States has fallen from a 1918 high of over 21 million to about 3 million in 1961. The book concludes with a guide to collections of fossil horses in the United States—the American Museum in New York has the world's best collection—and an annotated bibliography.

Man and Dolphin. JOHN C. LILLY. 1961. Doubleday & Co., Inc., Garden City, N. Y. 312 pp., illus. $4.95.

A lively account of the early stages in the investigation of the behavior and intelligence of dolphins. The author began his studies in Florida, and has continued them at his own private laboratory in the Virgin Islands set up with aid from the National Science Foundation and the Office of Naval Research. Dr. Lilly suspects that the dolphin, *Tursiops truncatus,* with a brain larger than a human's, definitely exceeds the apes in intelligences. He hopes eventually to enter into communication with them! The illustrations include 24 pages of photographs and the account has a full bibliography.

The Life and Death of Cells. JOSEPH G. HOFFMAN. 1961. Doubleday Dolphin Books. 354 pp. 95¢.

This is a reprint of a book first published in 1957. It considers living phenomena at the cellular level with only moderate explorations into biochemical phenomena below and organismic phenomena above that level. The author employs surprisingly simple language with a minimum of technical terms, but this simplicity is, in part, deceptive, because the book is a thoroughly sophisticated exploration in depth of important aspects of biological systems. The fact that the author is a biophysicist concerned with cancer research gives his point of view, and mice and radiation and cancer cells appear frequently in his discussions. The book exemplifies the possibility of writing profoundly in simple language and is one that anyone interested in biology can read with profit. There is no bibliography.

Textbook of Physiology. W. W. TUTTLE and BYRON A. SCHOTTELIUS. ed. 14. 1961. C. V. Mosby Co., St. Louis. 547 pp., 313 fig., five color plates. $7.00.

Elementary Human Physiology. TERENCE A. ROGERS. 1961. John Wiley & Sons, Inc., New York. 417 pp., illus. $6.50.

These are texts designed for use in undergraduate college courses in human physiology without other prerequisite than, perhaps, some high school chemistry.

The first text gives a bit more attention to the hygienic aspects of the subject than the second, which is more strictly confined to normal function. The first text has no bibliography; the second has frequent lists of references to popular articles in the *Scientific American*.

The Evolution of Human Nature. C. JUDSON HERRICK. 1961. Harper & Bros., New York. 500 pp. $2.45.

This is a widely ranging study of psychobiology first published in 1956. It was written by a neurologist with wide scientific and philosophical interests. The point of view is naturalistic and, in some measure, behavioristic, but the author insists that no study of mind and mentation is adequate that does not recognize self-consciousness and the results of introspectation. Great problems in psychobiology remain unsolved of which, perhaps, the greatest is the elucidation of the mechanism that produces self-consciousness. The book is elaborately documented and presents the thoughtful results of many decades of reflection and study on the part of its author.

Cell and Psyche. The Biology of Purpose. EDMUND W. SINNOTT. 1961. Harper & Bros., New York. 119 pp. $.95.

The thesis of this charming little book, first published in 1950, is that the purposive and idealistic behavior of the human mind is continuous with the organizing morphogenetic activity of the developing embryo. Neither one of these systems, the embryo or the psyche, are very well understood yet. The author suggests, however, that their "purposive" activity may be as revealing of aspects of reality as the traditional mechanistic ones and that these "purposive" aspects of the universe may extend beyond the realm of protoplasm as we know it. The author is an eminent geneticist. Most of his discussion is based on conventional biological and psychological data with his entrée into metaphysical matters confined to a few pages at the end. The reviewer finds the consideration of freedom most illuminating, especially as it represents the psyche as a portion of reality developing self-awareness. The book is recommended to persons interested in a brief, simple, straightforward examination of some of the philosophical implications of biology; it concludes with a bibliography of suggested readings.

Human Heredity. JEAN ROSTRAND. 1961. Philosophical Library, New York, 139 pp., 12 figs. $4.75.

This is a concise, authentic, conservative account of human heredity, translated from the French by Wade Baskin. It contains an interesting list of "Mendelian Characters" in man and two pages of selected readings.

Concepts of Medicine. A Collection of Essays on Aspects of Medicine. Edited by BRANDON LUSH. 1961. Pergamon Press, New York. 286 pp., illus. $8.50.

This is an anthology of 26 essays mostly published between 1950 and 1958 and over half taken from *The Lancet*. They are not research reports but treat of various aspects of the theory and practice of medicine. "Teachers of Medicine," "Twenty-five Years of Country Practice," "The Meaning of Normal," "On The Philosophy of Research," and "The Evolution of the Concept of Disease" are examples. A book that can be read by all interested in medicine: student, teacher, practitioner, and patient.

Control of Ovulation. Edited by CLAUDE A. VILLEE. 1961. Pergamon Press, New York. 251 pp., illus. $10.00.

This book consists of twelve papers given at a conference held on February 26–28, 1960, at Endicott House, Dedham, Massachusetts, under the sponsorship of Harvard University and the Association for the Aid of Crippled Children of New York City. It reviews the control of ovulation in chickens, rats, rabbits, sheep, cattle, monkeys, and man. The last chapter by Dr. John Rock reviews the nearly 99%

successful suppression of ovulation in 830 women in Puerto Rico and Haiti by daily doses of 10 mg. of Enovid (9.85 mg. of norethynodrel and 0.15 mg. of the 3-methyl-ether of ethynylestradiol) on days 5 through 24 inclusive of the menstrual cycle.

Advances in Thyroid Research. Transactions of the Fourth International Goitre Conferences, London, July, 1960. Edited by ROSALIND PITT-RIVERS. 1961. Pergamon Press, New York. 537 pp., illus. $20.00.

This is a collection of 96 papers (5 in French, 1 in German) on thyroid research. An interesting *First Dunhill Memorial Lecture* by Sir Geoffrey Keynes details the life of Sir Thomas Dunhill (b. 1876) who in Melbourne and later in London, in the period following 1907, pioneered surgical techniques for thyroidectomy. Full bibliography.

Ra'ivavae. An Expedition to the Most Fascinating and Mysterious Island in Polynesia. DONALD MARSHALL. 1961. Doubleday, Garden City, New York. 301 pp., illus. $4.95.

Ra'ivavae is a Polynesian island south of Tahiti. Between 1826 and 1834 its population of over 3000 inhabitants was decimated by disease to less than 100 persons. This coupled with the influence of Christian missionaries served largely to sever the ties of the survivors with their past so that a peculiar cultural situation now prevails. This book is a popular account by a trained anthropologist of his visit to the island in 1957 in the course of which he attempted to reconstruct the amazing erotic and religious customs of the inhabitants of 150 years ago. At the same time he was investigating the current cultural situation of the present population that now consists of about 750 persons. Recommended reading both for those enjoying a true modern adventure story and those who would revaluate their own culture against a radically different one. The author is Curator of Anthropology in the Peabody Museum. A technical report of his findings will be published shortly as *An Ethnography of Ra'ivavae.*

Animal Drawing. Anatomy and Action for Artists. CHARLES R. KNIGHT. 1960. Dover Publications, New York. 149 pp., 160 figs. $2.00.

This is a reissue of a book first published in 1947 under the title *Animal Anatomy and Psychology for Artists and Laymen.* Its author is famous for his murals, paintings and bronzes in The American Museum of Natural History and other museums. The book consists of practical suggestions for drawing living animals with a few notes on the history of the art. For the most part it concerns mammals, but some attention is given to birds, and a glance is given to reptiles, fishes, crustaceans, and mollusks. As the result of a long experience in teaching freshman zoology, the reviewer is sure that Knight is in error in representing the tips of the fourth and fifth legs of the lobster on page 142. Only one of the terminal pieces is movable; the other is an extension of the penultimate segment!

The Kybernetics of Natural Systems. A Study in Patterns of Control. D. and K. STANLEY-JONES. 1960. Pergamon Press, New York. 145 pp. $6.50.

Kybernetics is the science of information-theory in connection with living structures. This book considers the matter of feed-back, beginning with such non-living systems as pulsating stars and runaway exploding stars. The feed-back elements in the nervous control of various invertebrates, lower vertebrates and mammals is then treated. The feed-back element in the higher vertebrates consists of special "muscle-spindles" that in mammals make up a mass of about one ten-thousandth that of the entire muscle. The "stretch" of these spindles supplies the minute feed-back stimuli that maintain the tone of the entire system of muscles. A final chapter suggests the application of feed-back theory to human societies, in which adequate political adjustments may be analogous to the neural control in the animal body and war may represent a runaway state.

Fundamentals of Nutrition. E. W. CRAMPTON and L. E. LLOYD, 1959. W. H. Freeman & Co., San Francisco. 494 pp., illus. $7.50.

This book is intended for undergraduate students in agriculture beginning their first serious consideration of the nutrition of domestic animals. While much of what is said applies to man, the main emphasis is on ruminants and other farm animals. Thus (p. 115) while there are 8 amino acids essential for humans, 10 are necessary for rats and 11 for chicks and it is possible that much smaller numbers are required for turkeys and pigs.

The book apparently presupposes a knowledge of general biology and organic chemistry. While the names of many organic compounds are mentioned, structural formulae are not used. Only a few selected references for further reading are given and, in general, the authors have adapted their book to the grade of advancement of the students for which it is intended. No effort is made to explain how the nutritional facts and pathways presented have been discovered. Pages 261 to 358 describe some of the methods used in the quantitative investigation of nutrition and the last hundred pages of the book (pp. 359–482) treat of the calculation of the nutrient needs of animals.

Comparative Effects of Radiation. Edited by MILTON BURTON, J. S. KIRBY-SMITH, and JOHN L. MAGEE. 1960. Wiley, New York. 426 pp., illus. $8.50.

This is a collection of 14 papers and accompanying discussion given at a conference held in San Juan at the University of Puerto Rico, February 15–19, 1960. These reviews represent some of the latest thought by radiation biologists, chemists, and physicists and deal with the initial chemical and physical steps in the action of radiation, especially those steps leading to biological effects. Special emphasis is given to the comparative effects of a wide variety of radiations. The book should be of great interest to all branches of radiation research.

On Population: Three Essays. THOMAS MALTHUS, JULIAN HUXLEY, FREDERICK OSBURN. 1960. New American Library. Mentor Book. 144 pp. 50¢.

This slim "paper back" surveys the urgent problem of population from three points of view. Malthus in 1830 could see no solution except late marriages, although he did suggest that there was a natural tendency for European populations to stabilize. Julian Huxley (1955) finds birth control the main answer. Frederick Osborn (1960) sees the problem in a broad sociological setting, though he has no single panacea for our difficulties.

Educational Psychology and Children. K. LOVELL. Ed. 2. 1959. Philosophical Library, New York. 272 pp. $6.00.

This is an interesting textbook by the Lecturer in Educational Psychology in the University of Leeds Institute of Education. It is written from the viewpoint of the teacher and with special reference to British methods and experience. The author is quite undogmatic in the development of his theme and in cases of disagreement refers to numerous points of view. The text is accompanied by extensive bibliographical footnotes.

Passport to Paradise . . . ? BERNARD FINCH. 1959. Philosophical Library, New York. 191 pp., 10 plates. $6.00.

This is an interesting account in popular language of drug plants, the drugs derived from them, and their effects for good or ill on humans. A terminal bibliography refers to additional reading as well as the sources of the author's information.

CHAPTERS FOUNDED

ALPHA—Ohio State University, Columbus, Ohio, 17 March 1915.

BETA—University of Michigan, Ann Arbor, Michigan, 3 June 1916.

GAMMA—North Dakota Agricultural College, Fargo, North Dakota (1916).

DELTA—University of Maine, Orono, Maine, 27 January 1917.

EPSILON—University of Denver, Denver, Colorado, 5 March 1917.

ZETA—University of Wisconsin, Madison, Wisconsin, 30 May 1917.

ETA—University of Akron, Akron, Ohio, 20 April 1921.

THETA—Michigan State College, Lansing, Michigan, 9 April 1921.

IOTA—Washington University, St. Louis, Missouri, 28 May 1921.

KAPPA—University of Kansas, Lawrence, Kansas, 31 May 1921.

LAMBDA—University of Montana, Missoula, Montana, 4 May 1921.

MU—University of California, Berkeley, California, 27 April 1922.

NU—Washington and Jefferson College, Washington, Pennsylvania, 11 May 1922.

XI—University of Nebraska, Lincoln, Nebraska, 3 May 1924.

OMICRON—University of North Dakota, Grand Forks, North Dakota, 26 May 1924.

PI—Emory University, Georgia, 3 January 1925.

RHO—University of Illinois, Urbana, Illinois, 28 March 1925.

SIGMA—University of Florida, Gainesville, Florida, 4 December 1925.

TAU—Duke University, Durham, North Carolina, 4 March 1926.

UPSILON—Miami University, Oxford, Ohio, 7 May 1926.

PHI—University of New Hampshire, Durham, New Hampshire, 21 May 1926.

CHI—Montana State College, Bozeman, Montana, 11 February 1927.

PSI—University of Washington, Seattle, Washington, 7 April 1928.

OMEGA—University of Oklahoma, Norman, Oklahoma, 24 March 1928.

ALPHA ALPHA—University of Southern California, Los Angeles, California, 17 May 1928.

ALPHA BETA—Mount Union College, Alliance, Ohio, 17 May 1928.

ALPHA GAMMA—University of South Dakota, Vermillion, South Dakota, 15 May 1928.

ALPHA DELTA—Lawrence College, Appleton Wisconsin, 17 March 1929.

ALPHA EPSILON—University of Pittsburgh, Pittsburgh, Pennsylvania, 23 March 1929.

ALPHA ZETA—College of William and Mary, Williamsburg, Virginia, 19 April 1930.

ALPHA ETA—Oklahoma State University, Stillwater, Oklahoma, 13 March 1930.

ALPHA THETA—State College of Washington, Pullman, Washington, May 1930.

ALPHA IOTA—Bucknell University, Lewisburg, Pennsylvania, 9 January 1932.

ALPHA KAPPA—Hunter College, New York City, 8 January 1932.

ALPHA LAMBDA—University of Utah, Salt Lake City, Utah, 13 February 1932.

ALPHA MU—University and State College of Oregon, Eugene-Portland-Corvallis, Oregon, 18 November 1933.

ALPHA NU—University of New Mexico, Albuquerque, New Mexico, 21 April 1935.

ALPHA XI—University of Rhode Island, Kingston, Rhode Island, 17 May 1935.

ALPHA OMICRON—Marquette University, Milwaukee, Wisconsin, 18 June 1938.

ALPHA PI—University of Colorado, Boulder, Colorado, 24 May 1941.

ALPHA RHO—University of Arkansas, Fayetteville, Arkansas, 23 May 1945.

ALPHA SIGMA—University of Texas, Austin, Texas, 2 February 1946.

ALPHA TAU—National University of Mexico, Mexico, D.F., 7 April 1947.

ALPHA UPSILON—University of California at Los Angeles, California, 17 May 1947.

ALPHA PHI—College of Puget Sound, Tacoma, Washington, 28 February 1948.

ALPHA CHI—University of the Philippines, Manila, Luzon, P.I., 12 March 1949.

ALPHA PSI—Virginia Polytechnic Institute, Blacksburg, Virginia, 24 May 1949.

ALPHA OMEGA—University of Georgia, Athens, Georgia, 17 May 1951.

BETA ALPHA—Pennsylvania State Univ., State College, Pennsylvania, 26 May 1955.

BETA BETA—Florida State University, Tallahassee, Florida, 18 February 1956.

BETA GAMMA—Long Island University Brooklyn N. Y., 27 April 1957.

BETA DELTA—University of Virginia, Charlottesville. Virginia, 22 March 1958.

BETA EPSILON, Northern Illinois University, DeKalb, Illinois.

BETA ZETA, University of Maryland, College Park, Maryland, May 1961.

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